Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

Gr.7 Mathematics---Mathematical Process Expectations

Representing

- ☐ **7m6** **SQC2005** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.7 Mathematics---Number Sense and Numeration

Quantity Relationships

- ☐ **7m11** **SQC2005** – represent, compare, and order decimals to hundredths and fractions, using a variety of tools (e.g., number lines, Cuisenaire rods, base ten materials, calculators);

Operational Sense

- ☐ **7m18** **SQC2005** – divide whole numbers by simple fractions and by decimal numbers to hundredths, using concrete materials (e.g., divide 3 by 1/2 using fraction strips; divide 4 by 0.8 using base ten materials and estimation);
- ☐ **7m20** **SQC2005** – solve problems involving the multiplication and division of decimal numbers to thousandths by one-digit whole numbers, using a variety of tools (e.g., concrete materials, drawings, calculators) and strategies (e.g., estimation, algorithms);
- ☐ **7m21** **SQC2005** – solve multi-step problems arising from real-life contexts and involving whole numbers and decimals, using a variety of tools (e.g., concrete materials, drawings, calculators) and strategies (e.g., estimation, algorithms);
- ☐ **7m22** **SQC2005** – use estimation when solving problems involving operations with whole numbers, decimals, and percents, to help judge the reasonableness of a solution (Sample problem: A book costs $18.49. The salesperson tells you that the total price, including taxes, is $22.37. How can you tell if the total price is reasonable without using a calculator?);
- ☐ **7m24** **SQC2005** – add and subtract fractions with simple like and unlike denominators, using a variety of tools (e.g., fraction circles, Cuisenaire rods, drawings, calculators) and algorithms;
- ☐ **7m25** **SQC2005** – demonstrate, using concrete materials, the relationship between the repeated addition of fractions and the multiplication of that fraction by a whole number (e.g., 1/2 + 1/2 + 1/2 = 3 x 1/2);

Proportional Relationships

- ☐ **7m28** **SQC2005** – solve problems that involve determining whole number percents, using a variety of tools (e.g., base ten materials, paper and pencil, calculators) (Sample problem: If there are 5 blue marbles in a bag of 20 marbles, what percent of the marbles are not blue?);

Gr.7 Mathematics---Measurement

Measurement Relationships

- ☐ **7m37** **SQC2005** – determine, through investigation using a variety of tools (e.g., concrete materials, dynamic geometry software) and strategies, the relationship for calculating the area of a trapezoid, and generalize to develop the formula [i.e., Area = (sum of lengths of parallel sides x height) ÷ 2] (Sample problem: Determine the relationship between the area of a parallelogram and the area of a trapezoid by composing a parallelogram from congruent trapezoids.);
- ☐ **7m40** **SQC2005** – determine, through investigation using a variety of tools and strategies (e.g., decomposing right prisms; stacking congruent layers of concrete materials to form a right prism), the relationship between the height, the area of the base, and the volume of right prisms with simple polygonal bases (e.g., parallelograms, trapezoids), and generalize to develop the formula (i.e., Volume = area of base x height) (Sample problem: Decompose right prisms with simple polygonal bases into triangular prisms and rectangular prisms. For each prism, record the area of the base, the height, and the volume on a chart. Identify relationships.);

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **7m41** **SQC2005** – determine, through investigation using a variety of tools (e.g., nets, concrete materials, dynamic geometry software, Polydrons), the surface area of right prisms;

Gr.7 Mathematics---Geometry and Spatial Sense

Geometric Properties

- ☐ **7m46** **SQC2005** – construct related lines (i.e., parallel; perpendicular; intersecting at 30º, 45º, and 60º), using angle properties and a variety of tools (e.g., compass and straight edge, protractor, dynamic geometry software) and strategies (e.g., paper folding);
- ☐ **7m47** **SQC2005** – sort and classify triangles and quadrilaterals by geometric properties related to symmetry, angles, and sides, through investigation using a variety of tools (e.g., geoboard, dynamic geometry software) and strategies (e.g., using charts, using Venn diagrams) (Sample problem: Investigate whether dilatations change the geometric properties of triangles and quadrilaterals.);
- ☐ **7m48** **SQC2005** – construct angle bisectors and perpendicular bisectors, using a variety of tools (e.g., Mira, dynamic geometry software, compass) and strategies (e.g., paper folding), and represent equal angles and equal lengths using mathematical notation;
- ☐ **7m49** **SQC2005** – investigate, using concrete materials, the angles between the faces of a prism, and identify right prisms (Sample problem: Identify the perpendicular faces in a set of right prisms.).

Geometric Relationships

- ☐ **7m51** **SQC2005** – determine, through investigation using a variety of tools (e.g., dynamic geometry software, concrete materials, geoboard), relationships among area, perimeter, corresponding side lengths, and corresponding angles of congruent shapes (Sample problem: Do you agree with the conjecture that triangles with the same area must be congruent? Justify your reasoning.);
- ☐ **7m53** **SQC2005** – distinguish between and compare similar shapes and congruent shapes, using a variety of tools (e.g., pattern blocks, grid paper, dynamic geometry software) and strategies (e.g., by showing that dilatations create similar shapes and that translations, rotations, and reflections generate congruent shapes) (Sample problem: A larger square can be composed from four congruent square pattern blocks. Identify another pattern block you can use to compose a larger shape that is similar to the shape of the block.).

Location and Movement

- ☐ **7m55** **SQC2005** – identify, perform, and describe dilatations (i.e., enlargements and reductions), through investigation using a variety of tools (e.g., dynamic geometry software, geoboard, pattern blocks, grid paper);
- ☐ **7m56** **SQC2005** – create and analyse designs involving translations, reflections, dilatations, and/or simple rotations of two-dimensional shapes, using a variety of tools (e.g., concrete materials, Mira, drawings, dynamic geometry software) and strategies (e.g., paper folding) (Sample problem: Identify transformations that may be observed in architecture or in artwork [e.g., in the art of M.C. Escher].);
- ☐ **7m57** **SQC2005** – determine, through investigation using a variety of tools (e.g., pattern blocks, Polydrons, grid paper, tiling software, dynamic geometry software, concrete materials), polygons or combinations of polygons that tile a plane, and describe the transformation(s) involved.

Gr.7 Mathematics---Patterning and Algebra

Overall Expectations

- ☐ **7m58** **SQC2005** • represent linear growing patterns (where the terms are whole numbers) using concrete materials, graphs, and algebraic expressions;

Patterns and Relationships

- ☐ **7m60** **SQC2005** – represent linear growing patterns, using a variety of tools (e.g., concrete materials, paper and pencil, calculators, spreadsheets) and strategies (e.g., make a table of values using the term number and the term; plot the coordinates on a graph; write a pattern rule using words);

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **7m61** **SQC2005** – make predictions about linear growing patterns, through investigation with concrete materials (Sample problem: Investigate the surface area of towers made from a single column of connecting cubes, and predict the surface area of a tower that is 50 cubes high. Explain your reasoning.);

Variables, Expressions, and Equations

- ☐ **7m66** **SQC2005** – translate phrases describing simple mathematical relationships into algebraic expressions (e.g., one more than three times a number can be written algebraically as 1 + 3x or 3x + 1), using concrete materials (e.g., algebra tiles, pattern blocks, counters);
- ☐ **7m69** **SQC2005** – solve linear equations of the form ax = c or c = ax and ax + b = c or variations such as b + ax = c and c = bx + a (where a, b, and c are natural numbers) by modelling with concrete materials, by inspection, or by guess and check, with and without the aid of a calculator (e.g., "I solved x + 7 = 15 by using guess and check. First I tried 6 for x. Since I knew that 6 plus 7 equals 13 and 13, is less than 15, then I knew that x must be greater than 6.").

Gr.7 Mathematics---Data Management and Probability

Collection and Organization of Data

- ☐ **7m74** **SQC2005** – collect and organize categorical, discrete, or continuous primary data and secondary data (e.g., electronic data from websites such as E-Stat or Census At Schools) and display the data in charts, tables, and graphs (including relative frequency tables and circle graphs) that have appropriate titles, labels (e.g., appropriate units marked on the axes), and scales (e.g., with appropriate increments) that suit the range and distribution of the data, using a variety of tools (e.g., graph paper, spreadsheets, dynamic statistical software);
- ☐ **7m75** **SQC2005** – select an appropriate type of graph to represent a set of data, graph the data using technology, and justify the choice of graph (i.e., from types of graphs already studied);

Gr.8 Mathematics---Mathematical Process Expectations

Representing

- ☐ **8m6** **SQC2005** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.8 Mathematics---Number Sense and Numeration

Operational Sense

- ☐ **8m16** **SQC2005** – solve multi-step problems arising from real-life contexts and involving whole numbers and decimals, using a variety of tools (e.g., graphs, calculators) and strategies (e.g., estimation, algorithms);
- ☐ **8m24** **SQC2005** – multiply and divide decimal numbers by various powers of ten (e.g., "To convert 230 000 cm^3 to cubic metres, I calculated in my head 230000 ÷ 10^6 to get 0.23 m^3.") (Sample problem: Use a calculator to help you generalize a rule for dividing numbers by 1 000 000.);
- ☐ **8m25** **SQC2005** – estimate, and verify using a calculator, the positive square roots of whole numbers, and distinguish between whole numbers that have whole-number square roots (i.e., perfect square numbers) and those that do not (Sample problem: Explain why a square with an area of 20 cm^2 does not have a whole-number side length.).

Proportional Relationships

- ☐ **8m27** **SQC2005** – solve problems involving proportions, using concrete materials, drawings, and variables (Sample problem: The ratio of stone to sand in HardFast Concrete is 2 to 3. How much stone is needed if 15 bags of sand are used?);

Gr.8 Mathematics---Measurement

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

Measurement Relationships

- ☐ **8m34 SQC2005** – measure the circumference, radius, and diameter of circular objects, using concrete materials (Sample Problem: Use string to measure the circumferences of different circular objects.);
- ☐ **8m35 SQC2005** – determine, through investigation using a variety of tools (e.g., cans and string, dynamic geometry software) and strategies, the relationships for calculating the circumference and the area of a circle, and generalize to develop the formulas [i.e., Circumference of a circle = π x diameter; Area of a circle = π x (radius)^2] (Sample problem: Use string to measure the circumferences and the diameters of a variety of cylindrical cans, and investigate the ratio of the circumference to the diameter.);
- ☐ **8m38 SQC2005** – determine, through investigation using concrete materials, the surface area of a cylinder (Sample problem: Use the label and the plastic lid from a cylindrical container to help determine its surface area.);

Gr.8 Mathematics---Geometry and Spatial Sense

Geometric Properties

- ☐ **8m43 SQC2005** – sort and classify quadrilaterals by geometric properties, including those based on diagonals, through investigation using a variety of tools (e.g., concrete materials, dynamic geometry software) (Sample problem: Which quadrilaterals have diagonals that bisect each other perpendicularly?);

Geometric Relationships

- ☐ **8m46 SQC2005** – determine, through investigation using a variety of tools (e.g., dynamic geometry software, concrete materials, geoboard), relationships among area, perimeter, corresponding side lengths, and corresponding angles of similar shapes (Sample problem: Construct three similar rectangles, using grid paper or a geoboard, and compare the perimeters and areas of the rectangles.);
- ☐ **8m47 SQC2005** – determine, through investigation using a variety of tools (e.g., dynamic geometry software, concrete materials, protractor) and strategies (e.g., paper folding), the angle relationships for intersecting lines and for parallel lines and transversals, and the sum of the angles of a triangle;
- ☐ **8m49 SQC2005** – determine the Pythagorean relationship, through investigation using a variety of tools (e.g., dynamic geometry software; paper and scissors; geoboard) and strategies;
- ☐ **8m51 SQC2005** – determine, through investigation using concrete materials, the relationship between the numbers of faces, edges, and vertices of a polyhedron (i.e., number of faces + number of vertices = number of edges + 2) (Sample problem: Use Polydrons and/or paper nets to construct the five Platonic solids [i.e., tetrahedron, cube, octahedron, dodecahedron, icosahedron], and compare the sum of the numbers of faces and vertices to the number of edges for each solid.).

Gr.8 Mathematics---Patterning and Algebra

Patterns and Relationships

- ☐ **8m56 SQC2005** – represent, through investigation with concrete materials, the general term of a linear pattern, using one or more algebraic expressions (e.g., "Using toothpicks, I noticed that 1 square needs 4 toothpicks, 2 connected squares need 7 toothpicks, and 3 connected squares need 10 toothpicks. I think that for n connected squares I will need 4 + 3(n – 1) toothpicks, because the number of toothpicks keeps going up by 3 and I started with 4 toothpicks. Or, if I think of starting with 1 toothpick and adding 3 toothpicks at a time, the pattern can be represented as 1 + 3n.");
- ☐ **8m57 SQC2005** – represent linear patterns graphically (i.e., make a table of values that shows the term number and the term, and plot the coordinates on a graph), using a variety of tools (e.g., graph paper, calculators, dynamic statistical software);

Gr.8 Mathematics---Data Management and Probability

Collection and Organization of Data

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **8m70** **SQC2005** – collect and organize categorical, discrete, or continuous primary data and secondary data (e.g., electronic data from websites such as E-Stat or Census At Schools), and display the data in charts, tables, and graphs (including histograms and scatter plots) that have appropriate titles, labels (e.g., appropriate units marked on the axes), and scales (e.g., with appropriate increments) that suit the range and distribution of the data, using a variety of tools (e.g., graph paper, spreadsheets, dynamic statistical software);
- ☐ **8m71** **SQC2005** – select an appropriate type of graph to represent a set of data, graph the data using technology, and justify the choice of graph (i.e., from types of graphs already studied, including histograms and scatter plots); – explain the relationship between a census, a representative sample, sample size, and a population (e.g., "I think that in most cases a larger sample size will be more representative of the entire population.").
- ☐ **8m72** **SQC2005** – explain the relationship between a census, a representative sample, sample size, and a population (e.g., "I think that in most cases a larger sample size will be more representative of the entire population.").

Probability

- ☐ **8m81** **SQC2005** – determine, through investigation, the tendency of experimental probability to approach theoretical probability as the number of trials in an experiment increases, using class-generated data and technology-based simulation models (Sample problem: Compare the theoretical probability of getting a 6 when tossing a number cube with the experimental probabilities obtained after tossing a number cube once, 10 times, 100 times, and 1000 times.);

Gr.12 Foundations for College Mathematics---Mathematics Process Specific Expectations MAP 4C

Representing

- ☐ **MPS 06** **CR2007** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.12 Foundations for College Mathematics---A. MATHEMATICAL MODELS MAP 4C

1. Solving Exponential Equations

- ☐ **MM1.03** **CR2007** 1.3 determine, through investigation using a variety of tools (e.g., calculator, paper and pencil, graphing technology) and strategies (e.g., patterning; finding values from a graph; interpreting the exponent laws), the value of a power with a rational exponent (i.e., $x^{m/n}$, where x > 0 and m and n are integers) Sample problem: The exponent laws suggest that $4^{1/2} \times 4^{1/2} = 4^1$. What value would you assign to $4^{1/2}$? What value would you assign to $27^{1/3}$? Explain your reasoning. Extend your reasoning to make a generalization about the meaning of $x^{1/n}$, where x > 0 and n is a natural number.
- ☐ **MM1.04** **CR2007** 1.4 evaluate, with or without technology, numerical expressions involving rational exponents and rational bases [e.g., 2^{-3}, $(-6)^3$, $4)^{1/2}$, 1.01^{120}]*
- ☐ **MM1.05** **CR2007** 1.5 solve simple exponential equations numerically and graphically, with technology (e.g., use systematic trial with a scientific calculator to determine the solution to the equation $1.05^x= 1.276$), and recognize that the solutions may not be exact Sample problem: Use the graph of $y = 3^x$ to solve the equation $3^x = 5$.
- ☐ **MM1.06** **CR2007** 1.6 solve problems involving exponential equations arising from real-world applications by using a graph or table of values generated with technology from a given equation [e.g., $h= 2(0.6)^n$, where h represents the height of a bouncing ball and n represents the number of bounces] Sample problem: Dye is injected to test pancreas function. The mass, Rgrams, of dye remaining in a healthy pancreas after t minutes is given by the equation $R= I(0.96)^t$, where I grams is the mass of dye initially injected. If 0.50 g of dye is initially injected into a healthy pancreas, determine how much time elapses until 0.35 g remains by using a graph and/or table of values generated with technology. *The knowledge and skills described in this expectation are to be introduced as needed, and applied and consolidated, where appropriate, throughout the course.

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **MM1.07 CR2007** 1.7 solve exponential equations in one variable by determining a common base (e.g., $2^x = 32$, $4^{5x-1} = 2^{2(x+11)}$, $3^{5x+8} = 27^x$) Sample problem: Solve $3^{5x+8} = 27^x$ by determining a common base, verify by substitution, and make connections to the intersection of $y = 3^{5x+8}$ and $y = 27^x$ using graphing technology.

2. Modelling Graphically

- ☐ **MM2.05 CR2007** 2.5 compare, through investigation with technology, the graphs of pairs of relations (i.e., linear, quadratic, exponential) by describing the initial conditions and the behaviour of the rates of change (e.g., compare the graphs of amount versus time for equal initial deposits in simple interest and compound interest accounts) Sample problem: In two colonies of bacteria, the population doubles every hour. The initial population of one colony is twice the initial population of the other. How do the graphs of population versus time compare for the two colonies? How would the graphs change if the population tripled every hour, instead of doubling?
- ☐ **MM2.06 CR2007** 2.6 recognize that a linear model corresponds to a constant increase or decrease over equal intervals and that an exponential model corresponds to a constant percentage increase or decrease over equal intervals, select a model (i.e., linear, quadratic, exponential) to represent the relationship between numerical data graphically and algebraically, using a variety of tools (e.g., graphing technology) and strategies (e.g., finite differences, regression), and solve related problems Sample problem: Given the data table at the top of page 139, determine an algebraic model to represent the relationship between population and time, using technology. Use the algebraic model to predict the population in 2015, and describe any assumptions made. Years after 1955 | Population of Geese 0 | 5 000, 10 | 12 000, 20 | 26 000, 30 | 62 000, 40 | 142 000, 50 | 260 000

3. Modelling Algebraically

- ☐ **MM3.03 CR2007** 3.3 make connections between formulas and linear, quadratic, and exponential functions [e.g., recognize that the compound interest formula, $A= P(1 + i)^n$, is an example of an exponential function A(n) when P and i are constant, and of a linear function A(P) when i and n are constant], using a variety of tools and strategies (e.g., comparing the graphs generated with technology when different variables in a formula are set as constants) Sample problem: Which variable(s) in the formula $V = \pi r^2 h$ would you need to set as a constant to generate a linear equation? A quadratic equation? Explain why you can expect the relationship between the volume and the height to be linear when the radius is constant.

Gr.12 Foundations for College Mathematics---B. PERSONAL FINANCE MAP 4C

Overall Expectations

- ☐ **PEV.01 CR2007** 1. demonstrate an understanding of annuities, including mortgages, and solve related problems using technology;
- ☐ **PEV.03 CR2007** 3. design, justify, and adjust budgets for individuals and families described in case studies, and describe applications of the mathematics of personal finance.

1. Understanding Annuities

- ☐ **PE1.02 CR2007** 1.2 determine, through investigation using technology (e.g., the TVM Solver on a graphing calculator; online tools), the effects of changing the conditions (i.e., the payments, the frequency of the payments, the interest rate, the compounding period) of an ordinary simple annuity (i.e., an annuity in which payments are made at the end of each period, and compounding and payment periods are the same) (e.g., long-term savings plans, loans) Sample problem: Given an ordinary simple annuity with semi-annual deposits of $1000, earning 6% interest per year compounded semi-annually, over a 20-year term, which of the following results in the greatest return: doubling the payments, doubling the interest rate, doubling the frequency of the payments and the compounding, or doubling the payment and compounding period?
- ☐ **PE1.03 CR2007** 1.3 solve problems, using technology (e.g., scientific calculator, spreadsheet, graphing calculator), that involve the amount, the present value, and the regular payment of an ordinary simple annuity Sample problem: Using a spreadsheet, calculate the total interest paid over the life of a $10 000 loan with monthly repayments over 2 years at 8% per year compounded monthly, and compare the total interest with the original principal of the loan.

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **PE1.04 CR2007** 1.4 demonstrate, through investigation using technology (e.g., a TVM Solver), the advantages of starting deposits earlier when investing in annuities used as long-term savings plans Sample problem: If you want to have a million dollars at age 65, how much would you have to contribute monthly into an investment that pays 7% per annum, compounded monthly, beginning at age 20? At age 35? At age 50?
- ☐ **PE1.07 CR2007** 1.7 generate an amortization table for a mortgage, using a variety of tools and strategies (e.g., input data into an online mortgage calculator; determine the payments using the TVM Solver on a graphing calculator and generate the amortization table using a spreadsheet), calculate the total interest paid over the life of a mortgage, and compare the total interest with the original principal of the mortgage
- ☐ **PE1.08 CR2007** 1.8 determine, through investigation using technology (e.g., TVM Solver, online tools, financial software), the effects of varying payment periods, regular payments, and interest rates on the length of time needed to pay off a mortgage and on the total interest paid Sample problem: Calculate the interest saved on a $100 000 mortgage with monthly payments, at 6% per annum compounded semi-annually, when it is amortized over 20 years instead of 25 years.

2. Renting or Owning Accommodation

- ☐ **PE2.03 CR2007** 2.3 solve problems, using technology (e.g., calculator, spreadsheet), that involve the fixed costs (e.g., mortgage, insurance, property tax) and variable costs (e.g., maintenance, utilities) of owning or renting accommodation Sample problem: Calculate the total of the fixed and variable monthly costs that are associated with owning a detached house but that are usually included in the rent for rental accommodation.

3. Designing Budgets

- ☐ **PE3.03 CR2007** 3.3 design, explain, and justify a monthly budget suitable for an individual or family described in a given case study that provides the specifics of the situation (e.g., income; personal responsibilities; costs such as utilities, food, rent/mortgage, entertainment, transportation, charitable contributions; long-term savings goals), with technology (e.g., using spreadsheets, budgeting software, online tools) and without technology (e.g., using budget templates)
- ☐ **PE3.05 CR2007** 3.5 make adjustments to a budget to accommodate changes in circumstances (e.g., loss of hours at work, change of job, change in personal responsibilities, move to new accommodation, achievement of a long-term goal, major purchase), with technology (e.g., spreadsheet template, budgeting software)

Gr.12 Foundations for College Mathematics---C. GEOMETRY AND TRIGONOMETRY MAP 4C

1. Solving Problems Involving Measurement and Geometry

- ☐ **GT1.01 CR2007** 1.1 perform required conversions between the imperial system and the metric system using a variety of tools (e.g., tables, calculators, online conversion tools), as necessary within applications

2. Investigating Optimal Dimensions

- ☐ **GT2.01 CR2007** 2.1 recognize, through investigation using a variety of tools (e.g., calculators; dynamic geometry software; manipulatives such as tiles, geoboards, toothpicks) and strategies (e.g., modelling; making a table of values; graphing), and explain the significance of optimal perimeter, area, surface area, and volume in various applications (e.g., the minimum amount of packaging material, the relationship between surface area and heat loss) Sample problem: You are building a deck attached to the second floor of a cottage, as shown below. Investigate how perimeter varies with different dimensions if you build the deck using exactly 48 1-m x 1-m decking sections, and how area varies if you use exactly 30 m of deck railing. Note: the entire outside edge of the deck will be railed. (omitted graph from page 142)
- ☐ **GT2.02 CR2007** 2.2 determine, through investigation using a variety of tools (e.g., calculators, dynamic geometry software, manipulatives) and strategies (e.g., modelling; making a table of values; graphing), the optimal dimensions of a two-dimensional shape in metric or imperial units for a given constraint (e.g., the dimensions that give the minimum perimeter for a given area) Sample problem: You are constructing a rectangular deck against your house. You will use 32 ft of railing and will leave a 4-ft gap in the railing for access to stairs. Determine the dimensions that will maximize the area of the deck.

3. Solving Problems Involving Trigonometry

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **GT3.02** **CR2007** 3.2 make connections between primary trigonometric ratios (i.e., sine, cosine, tangent) of obtuse angles and of acute angles, through investigation using a variety of tools and strategies (e.g., using dynamic geometry software to identify an obtuse angle with the same sine as a given acute angle; using a circular geoboard to compare congruent triangles; using a scientific calculator to compare trigonometric ratios for supplementary angles)

- ☐ **GT3.04** **CR2007** 3.4 solve problems involving oblique triangles, including those that arise from real-world applications, using the sine law (in non-ambiguous cases only) and the cosine law, and using metric or imperial units Sample problem: A plumber must cut a piece of pipe to fit from A to B. Determine the length of the pipe. (omitted graph from page 143)

Gr.12 Foundations for College Mathematics---D. DATA MANAGEMENT MAP 4C

1. Working With Two-Variable Data

- ☐ **DM1.03** **CR2007** 1.3 collect two-variable data from primary sources, through experimentation involving observation or measurement, or from secondary sources (e.g., Internet databases, newspapers, magazines), and organize and store the data using a variety of tools (e.g., spreadsheets, dynamic statistical software) Sample problem: Download census data from Statistics Canada on age and average income, store the data using dynamic statistics software, and organize the data in a summary table.
- ☐ **DM1.04** **CR2007** 1.4 create a graphical summary of two-variable data using a scatter plot (e.g., by identifying and justifying the dependent and independent variables; by drawing the line of best fit, when appropriate), with and without technology
- ☐ **DM1.05** **CR2007** 1.5 determine an algebraic summary of the relationship between two variables that appear to be linearly related (i.e., the equation of the line of best fit of the scatter plot), using a variety of tools (e.g., graphing calculators, graphing software) and strategies (e.g., using systematic trials to determine the slope and y-intercept of the line of best fit; using the regression capabilities of a graphing calculator), and solve related problems (e.g., use the equation of the line of best fit to interpolate or extrapolate from the given data set)

Gr.11 Foundations for College Mathematics---Mathematics Process Specific Expectations MBF 3C

Representing

- ☐ **MPS.06** **CR2006** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.11 Foundations for College Mathematics---Mathematical Models MBF 3C

Connecting Graphs and Equations of Quadratic Relations

- ☐ **MM1.03** **CR2006** – determine, through investigation using technology, and describe the roles of a, h, and k in quadratic relations of the form $y = a(x - h)^2 + k$ in terms of transformations on the graph of $y = x^2$ (i.e., translations; reflections in the x-axis; vertical stretches and compressions) [Sample problem: Investigate the graph $y = 3(x - h)^2 + 5$ for various values of h, using technology, and describe the effects of changing h in terms of a transformation.];
- ☐ **MM1.06** **CR2006** – express the equation of a quadratic relation in the standard form $y = ax^2 + bx + c$, given the vertex form $y = a(x - h)^2 + k$, and verify, using graphing technology, that these forms are equivalent representations [Sample problem: Given the vertex form $y = 3(x - 1)^2 + 4$, express the equation in standard form. Use technology to compare the graphs of these two forms of the equation.];

Connecting Graphs and Equations of Exponential Relations

- ☐ **MM2.01** **CR2006** – determine, through investigation using a variety of tools and strategies (e.g., graphing with technology; looking for patterns in tables of values), and describe the meaning of negative exponents and of zero as an exponent;

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **MM2.02 CR2006** – evaluate,with and without technology, numerical expressions containing integer exponents and rational bases (e.g., 2^{-3}, 6^3, 3456^0, 1.03^{10});
- ☐ **MM2.03 CR2006** – determine, through investigation (e.g., by patterning with and without a calculator), the exponent rules for multiplying and dividing numerical expressions involving exponents [e.g., $(1/2)^3$ x $(1/2)^2$], and the exponent rule for simplifying numerical expressions involving a power of a power [e.g., $(53)^2$];

Solving Problems Involving Exponential Relations

- ☐ **MM3.01 CR2006** – collect data that can be modelled as an exponential relation, through investigation with and without technology, from primary sources, using a variety of tools (e.g., concrete materials such as number cubes, coins; measurement tools such as electronic probes), or from secondary sources (e.g.,websites such as Statistics Canada, E-STAT), and graph the data (Sample problem: Collect data and graph the cooling curve representing the relationship between temperature and time for hot water cooling in a porcelain mug. Predict the shape of the cooling curve when hot water cools in an insulated mug.Test your prediction.);
- ☐ **MM3.02 CR2006** – describe some characteristics of exponential relations arising from real-world applications (e.g., bacterial growth, drug absorption) by using tables of values (e.g., to show a constant ratio, or multiplicative growth or decay) and graphs (e.g., to show, with technology, that there is no maximum or minimum value);
- ☐ **MM3.03 CR2006** – pose and solve problems involving exponential relations arising from a variety of real-world applications (e.g., population growth, radioactive decay, compound interest) by using a given graph or a graph generated with technology from a given equation (Sample problem: Given a graph of the population of a bacterial colony versus time, determine the change in population in the first hour.);

Gr.11 Foundations for College Mathematics---Personal Finance MBF 3C

Solving Problems Involving Compound Interest

- ☐ **PF1.01 CR2006** – determine, through investigation using technology, the compound interest for a given investment, using repeated calculations of simple interest, and compare, using a table of values and graphs, the simple and compound interest earned for a given principal (i.e., investment) and a fixed interest rate over time (Sample problem: Compare, using tables of values and graphs, the amounts after each of the first five years for a $1000 investment at 5% simple interest per annum and a $1000 investment at 5% interest per annum, compounded annually.);
- ☐ **PF1.02 CR2006** – determine, through investigation (e.g., using spreadsheets and graphs), and describe the relationship between compound interest and exponential growth;
- ☐ **PF1.03 CR2006** – solve problems, using a scientific calculator, that involve the calculation of the amount, A (also referred to as future value, FV), and the principal, P (also referred to as present value, PV), using the compound interest formula in the form $A = P(1 + i)^n$ [or $FV = PV (1 + i)^n$] (Sample problem: Calculate the amount if $1000 is invested for 3 years at 6% per annum, compounded quarterly.);
- ☐ **PF1.05 CR2006** – solve problems, using a TVM Solver in a graphing calculator or on a website, that involve the calculation of the interest rate per compounding period, i, or the number of compounding periods, n, in the compound interest formula $A = P(1 + i)^n$ [or $FV = PV (1 + i)^n$] (Sample problem: Use the TVM Solver in a graphing calculator to determine the time it takes to double an investment in an account that pays interest of 4% per annum, compounded semi-annually.);
- ☐ **PF1.06 CR2006** – determine, through investigation using technology (e.g., a TVM Solver in a graphing calculator or on a website), the effect on the future value of a compound interest investment or loan of changing the total length of time, the interest rate, or the compounding period (Sample problem: Investigate whether doubling the interest rate will halve the time it takes for an investment to double.).

Comparing Financial Services

- ☐ **PF2.04 CR2006** – gather, interpret, and compare information about current credit card interest rates and regulations, and determine, through investigation using technology, the effects of delayed payments on a credit card balance;

Owning and Operating a Vehicle

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **PF3.03** **CR2006** – solve problems, using technology (e.g., calculator, spreadsheet), that involve the fixed costs (e.g., licence fee, insurance) and variable costs (e.g., maintenance, fuel) of owning and operating a vehicle (Sample problem: The rate at which a car consumes gasoline depends on the speed of the car. Use a given graph of gasoline consumption, in litres per 100 km, versus speed, in kilometres per hour, to determine how much gasoline is used to drive 500 km at speeds of 80 km/h, 100 km/h, and 120 km/h. Use the current price of gasoline to calculate the cost of driving 500 km at each of these speeds.).

Gr.11 Foundations for College Mathematics---Geometry and Trigonometry MBF 3C

Representing Two-Dimensional Shapes and Three-Dimensional Figures

- ☐ **GT1.01** **CR2006** – identify real-world applications of geometric shapes and figures, through investigation (e.g., by importing digital photos into dynamic geometry software), in a variety of contexts (e.g., product design, architecture, fashion), and explain these applications (e.g., one reason that sewer covers are round is to prevent them from falling into the sewer during removal and replacement) (Sample problem: Explain why rectangular prisms are used for packaging many products.);
- ☐ **GT1.02** **CR2006** – represent three-dimensional objects, using concrete materials and design or drawing software, in a variety of ways (e.g., orthographic projections [i.e., front, side, and top views]; perspective isometric drawings; scale models);

Applying the Sine Law and the Cosine Law in Acute Triangles

- ☐ **GT2.02** **CR2006** – verify, through investigation using technology (e.g., dynamic geometry software, spreadsheet), the sine law and the cosine law (e.g., compare, using dynamic geometry software, the ratios a/sinA , b/sinB , and c/sinC in triangle ABC while dragging one of the vertices);

Gr.11 Foundations for College Mathematics---Data Management MBF 3C

Working With One-Variable Data

- ☐ **DM1.02** **CR2006** – collect one-variable data from secondary sources (e.g., Internet databases), and organize and store the data using a variety of tools (e.g., spreadsheets, dynamic statistical software);
- ☐ **DM1.05** **CR2006** – identify different types of one-variable data (i.e., categorical, discrete, continuous), and represent the data, with and without technology, in appropriate graphical forms (e.g., histograms, bar graphs, circle graphs, pictographs);
- ☐ **DM1.07** **CR2006** – calculate, using formulas and/or technology (e.g., dynamic statistical software, spreadsheet, graphing calculator), and interpret measures of central tendency (i.e., mean, median, mode) and measures of spread (i.e., range, standard deviation);

Applying Probability

- ☐ **DM2.05** **CR2006** – determine, through investigation using class-generated data and technology-based simulation models (e.g., using a random-number generator on a spreadsheet or on a graphing calculator), the tendency of experimental probability to approach theoretical probability as the number of trials in an experiment increases (e.g.,?If I simulate tossing a coin 1000 times using technology, the experimental probability that I calculate for tossing tails is likely to be closer to the theoretical probability than if I only simulate tossing the coin 10 times?) (Sample problem: Calculate the theoretical probability of rolling a 2 on a number cube. Simulate rolling a number cube, and use the simulation to calculate the experimental probability of rolling a 2 after 10, 20, 30, ..., 200 trials. Graph the experimental probability versus the number of trials, and describe any trend.);

Gr.11 Functions and Applications---Mathematics Process Specific Expectations MCF 3M

Representing

- ☐ **MPS.06** **CR2006** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

Gr.11 Functions and Applications---Quadratic Functions MCF 3M

Solving Quadratic Equations

- ☐ **QF1.06** **CR2006** – explore the algebraic development of the quadratic formula (e.g., given the algebraic development, connect the steps to a numerical example; follow a demonstration of the algebraic development, with technology, such as computer algebra systems, or without technology [student reproduction of the development of the general case is not required]), and apply the formula to solve quadratic equations, using technology;

Connecting Graphs and Equations of Quadratic Functions

- ☐ **QF2.05** **CR2006** – determine, through investigation using technology, and describe the roles of a, h,and k in quadratic functions of the form $f(x) = a(x- h)^2 + k$ in terms of transformations on the graph of $f(x) = x^2$ (i.e., translations; reflections in the x-axis; vertical stretches and compressions) [Sample problem: Investigate the graph $f(x) = 3(x- h)^2 + 5$ for various values of h, using technology, and describe the effects of changing h in terms of a transformation.];
- ☐ **QF2.07** **CR2006** – express the equation of a quadratic function in the standard form $f(x) = ax^2+ bx + c$, given the vertex form $f(x) = a(x- h)^2 + k$, and verify, using graphing technology, that these forms are equivalent representations [Sample problem: Given the vertex form $f(x) = 3(x-1)^2 + 4$, express the equation in standard form. Use technology to compare the graphs of these two forms of the equation.];
- ☐ **QF2.08** **CR2006** – express the equation of a quadratic function in the vertex form $f(x) = a(x- h)^2 + k$, given the standard form $f(x) = ax^2+ bx + c$, by completing the square (e.g., using algebra tiles or diagrams; algebraically), including cases where b/a is a simple rational number (e.g., 1/2 , 0.75), and verify, using graphing technology, that these forms are equivalent representations;

Solving Problems Involving Quadratic Functions

- ☐ **QF3.01** **CR2006** – collect data that can be modelled as a quadratic function, through investigation with and without technology, from primary sources, using a variety of tools (e.g., concrete materials; measurement tools such as measuring tapes, electronic probes, motion sensors), or from secondary sources (e.g., websites such as Statistics Canada, E-STAT), and graph the data (Sample problem: When a 3 x 3 x 3 cube made up of 1 x 1 x 1 cubes is dipped into red paint, 6 of the smaller cubes will have 1 face painted. Investigate the number of smaller cubes with 1 face painted as a function of the edge length of the larger cube, and graph the function.);
- ☐ **QF3.02** **CR2006** – determine, through investigation using a variety of strategies (e.g., applying properties of quadratic functions such as the x-intercepts and the vertex; using transformations), the equation of the quadratic function that best models a suitable data set graphed on a scatter plot, and compare this equation to the equation of a curve of best fit generated with technology (e.g., graphing software, graphing calculator);

Gr.11 Functions and Applications---Exponential Functions MCF 3M

Connecting Graphs and Equations Exponential Functions

- ☐ **EF1.01** **CR2006** – determine, through investigation using avariety of tools (e.g., calculator, paper and pencil, graphing technology) and strategies (e.g., patterning; finding values from a graph; interpreting the exponent laws), the value of a power with a rational exponent (i.e.,x,where x>0 and m and n are integers) (Sample problem:The exponent laws suggest that $4^{1/2} \times 4^{1/2} = 4^1$. What value would you assign to $4^{1/2}$? What value would you assign to $27^{1/3}$? Explain your reasoning. Extend your reasoning to make a generalization about the meaning of $x^{1/n}$, where x > 0 and n is a natural number.);
- ☐ **EF1.02** **CR2006** – evaluate, with and without technology, numerical expressions containing integer and rational exponents and rational bases [e.g., 2^{-3}, $(-6)^3$, $4^{1/2}$, 1.01^{120}];
- ☐ **EF1.03** **CR2006** – graph, with and without technology, an exponential relation, given its equation in the form $y = a^x$ ($a > 0$, $a \neq 1$), define this relation as the function $f(x) = a^x$, and explain why it is a function;

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **EF1.05** **CR2006** – determine, through investigation (e.g., by patterning with and without a calculator), the exponent rules for multiplying and dividing numerical expressions involving exponents [e.g., $(1/2)^3 \times (1/2)^2$], and the exponent rule for simplifying numerical expressions involving a power of a power [e.g.,$(5^3)^2$], and use the rules to simplify numerical expressions containing integer exponents [e.g., $(2^3)\ (2^5) = 28$];

Solving Problems Involving Exponential Functions

- ☐ **EF2.01** **CR2006** – collect data that can be modelled as an exponential function, through investigation with and without technology, from primary sources, using a variety of tools (e.g., concrete materials such as number cubes, coins; measurement tools such as electronic probes), or from secondary sources (e.g., websites such as Statistics Canada, E-STAT), and graph the data (Sample problem: Collect data and graph the cooling curve representing the relationship between temperature and time for hot water cooling in a porcelain mug. Predict the shape of the cooling curve when hot water cools in an insulated mug. Test your prediction.);

Solving Financial Problems Involving Exponential Functions

- ☐ **EF3.02** **CR2006** – solve problems, using a scientific calculator, that involve the calculation of the amount, A (also referred to as future value, FV), and the principal, P (also referred to as present value, PV), using the compound interest formula in the form $A = P(1 + i)^n$ [or $FV = PV(1 + i)^n$](Sample problem: Calculate the amount if $1000 is invested for three years at 6% per annum, compounded quarterly.);
- ☐ **EF3.03** **CR2006** – determine, through investigation (e.g., using spreadsheets and graphs), that compound interest is an example of exponential growth [e.g., the formulas for compound interest, $A = P(1 + i)^n$, and present value, $PV = A(1 + i)^{-n}$, are exponential functions, where the number of compounding periods, n, varies] [Sample problem: Describe an investment that could be represented by the function $f(x) = 500(1.01)^x$];
- ☐ **EF3.04** **CR2006** – solve problems, using a TVM Solver in a graphing calculator or on a website, that involve the calculation of the interest rate per compounding period, i, or the number of compounding periods, n, in the compound interest formula $A = P(1 + i)^n$ [or $FV = PV(1 + i)^n$],(Sample problem: Use the TVM Solver in a graphing calculator to determine the time it takes to double an investment in an account that pays interest of 4% per annum, compounded semi-annually.);
- ☐ **EF3.05** **CR2006** – explain the meaning of the term annuity, through investigation of numerical and graphical representations using technology;
- ☐ **EF3.06** **CR2006** – determine, through investigation using technology (e.g., the TVM Solver in a graphing calculator; online tools), the effects of changing the conditions (i.e., the payments, the frequency of the payments, the interest rate, the compounding period) of ordinary annuities in situations where the compounding period and the payment period are the same (e.g., long-term savings plans, loans) (Sample problem: Compare the amounts at age 65 that would result from making an annual deposit of $1000 starting at age 20, or from making an annual deposit of $3000 starting at age 50, to an RRSP that earns 6% interest per annum, compounded annually. What is the total of the deposits in each situation?);
- ☐ **EF3.07** **CR2006** – solve problems, using technology (e.g., scientific calculator, spreadsheet, graphing calculator), that involve the amount, the present value, and the regular payment of an ordinary annuity in situations where the compounding period and the payment period are the same (e.g., calculate the total interest paid over the life of a loan, using a spreadsheet, and compare the total interest with the original principal of the loan).

Gr.11 Functions and Applications---Trigonometric Functions MCF 3M

Applying the Sine Law and the Cosine Law in Acute Triangles

- ☐ **TF1.03** **CR2006** – verify, through investigation using technology (e.g., dynamic geometry software, spreadsheet), the sine law and the cosine law (e.g., compare, using dynamic geometry software, the ratios a/sin A, b/sinB, and c/sinC in triangle ABC while dragging one of the vertices);

Connecting Graphs and Equations of Sine Functions

- ☐ **TF2.03** **CR2006** – make connections between the sine ratio and the sine function by graphing the relationship between angles from 0° to 360° and the corresponding sine ratios, with or without technology (e.g., by generating a table of values using a calculator; by unwrapping the unit circle), defining this relationship as the function f(x) = sinx, and explaining why it is a function;

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

☐ **TF2.05** **CR2006** – make connections, through investigation with technology, between changes in a real-world situation that can be modelled using a periodic function and transformations of the corresponding graph (e.g., investigating the connection between variables for a swimmer swimming lengths of a pool and transformations of the graph of distance from the starting point versus time) (Sample problem: Generate a sine curve by walking a circle of two-metre diameter in front of a motion sensor. Describe how the following changes in the motion change the graph: starting at a different point on the circle; starting a greater distance from the motion sensor; changing direction; increasing the radius of the circle; and increasing the speed);

☐ **TF2.06** **CR2006** – determine, through investigation using technology, and describe the roles of the parameters a, c,and d in functions in the form f(x) = a sinx, f(x) = sinx + c, and f(x) = sin(x - d) in terms of transformations on the graph of f(x) = sinx with angles expressed in degrees (i.e., translations; reflections in the x-axis; vertical stretches and compressions);

Solving Problems Involving Sine Functions

☐ **TF3.01** **CR2006** – collect data that can be modelled as a sine function (e.g., voltage in an AC circuit, sound waves), through investigation with and without technology, from primary sources, using a variety of tools (e.g., concrete materials; measurement tools such as motion sensors), or from secondary sources (e.g., websites such as Statistics Canada, E-STAT), and graph the data (Sample problem: Measure and record distance-time data for a swinging pendulum, using a motion sensor or other measurement tools, and graph the data.);

☐ **TF3.03** **CR2006** – pose and solve problems based on applications involving a sine function by using a given graph or a graph generated with technology from its equation [Sample problem: The height above the ground of a rider on a Ferris wheel can be modelled by the sine function h(x) = 25sin(x - 90°) + 27, where h(x) is the height, in metres, and x is the angle, in degrees, that the radius to the rider makes with the horizontal. Graph the function, using graphing technology in degree mode, and determine the maximum and minimum heights of the rider, and the measures of the angle when the height of the rider is 40 m.].

Gr.11 Functions---Mathematics Process Specific Expectations MCR 3U

Representing

☐ **MPS.06** **CR2006** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.11 Functions---Characteristics of Functions MCR 3U

Representing Functions

☐ **CF1.05** **CR2006** – determine the numeric or graphical representation of the inverse of a linear or quadratic function, given the numeric, graphical, or algebraic representation of the function, and make connections, through investigation using a variety of tools (e.g., graphing technology, Mira, tracing paper), between the graph of a function and the graph of its inverse (e.g., the graph of the inverse is the reflection of the graph of the function in the line y = x) (Sample problem: Given a graph and a table of values representing population over time, produce a table of values for the inverse and graph the inverse on a new set of axes.);

☐ **CF1.07** **CR2006** – determine, using function notation when appropriate, the algebraic representation of the inverse of a linear or quadratic function, given the algebraic representation of the function [e.g., $f(x) = (x - 2)^2 - 5$],and make connections, through investigation using a variety of tools (e.g., graphing technology, Mira, tracing paper), between the algebraic representations of a function and its inverse (e.g., the inverse of a linear function involves applying the inverse operations in the reverse order) (Sample problem: Given the equations of several linear functions, graph the functions and their inverses, determine the equations of the inverses, and look for patterns that connect the equation of each linear function with the equation of the inverse.);

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **CF1.08** **CR2006** – determine, through investigation using technology, and describe the roles of the parameters a, k, d,and c in functions of the form y = af (k(x - d))+ c in terms of transformations on the graphs of f (x) = x, f (x) = x^2, f (x) = √x,and f (x) = 1/x (i.e., translations; reflections in the axes; vertical and horizontal stretches and compressions) [Sample problem: Investigate the graph f (x) = 3$(x - d)^2$ + 5 for various values of d, using technology, and describe the effects of changing d in terms of a transformation.];

Solving Problems Involving Quadratic Functions

- ☐ **CF2.01** **CR2006** – determine the number of zeros (i.e., x-intercepts) of a quadratic function, using a variety of strategies (e.g., inspecting graphs; factoring; calculating the discriminant) (Sample problem: Investigate, using graphing technology and algebraic techniques, the transformations that affect the number of zeros for a given quadratic function.);

Determining Equivalent Algebraic Expressions*

- ☐ **CF3.02** **CR2006** – verify, through investigation with and without technology, that √ab = √a x √b, a = 0, b = 0, and use this relationship to simplify radicals (e.g., √24) and radical expressions obtained by adding, subtracting, and multiplying [e.g., (2 + √6) (3 - √12)].

Gr.11 Functions---Exponential Functions MCR 3U

Representing Exponential Functions

- ☐ **EF1.01** **CR2006** – graph, with and without technology, anexponential relation, given its equation in the form y=a^x (a > 0, a ≠1), define this relation as the function f(x) =a^x, and explain why it is a function;
- ☐ **EF1.02** **CR2006** – determine, through investigation using a variety of tools (e.g., calculator, paper and pencil, graphing technology) and strategies (e.g., patterning;finding values from a graph;interpreting the exponent laws), the value of a power with a rational exponent (i.e., x, where x >0 and m and n are integers) (Sample problem:The exponent laws suggest that $4^{1/2}$ x $4^{1/2}$ = 4^1 .What value would you assign to $4^{1/2}$? What value would you assign to $27^{1/3}$? Explain your reasoning. Extend your reasoning to make a generalization about the meaning of $x^{1/n}$,where x > 0 and n is a natural number.);

Connecting Graphs and Equations of Exponential Functions

- ☐ **EF2.02** **CR2006** – determine, through investigation using technology, and describe the roles of the parameters a, k, d,and c in functions of the form y = af(k(x - d)) + c in terms of transformations on the graph of f(x) = a^x(a > 0,a ≠ 1) (i.e., translations; reflections in the axes; vertical and horizontal stretches and compressions) [Sample problem: Investigate the graph f(x) =3x - d- 5 for various values of d, using technology, and describe the effects of changing d in terms of a transformation.];
- ☐ **EF2.04** **CR2006** – determine, through investigation using technology, that the equation of a given exponential function can be expressed using different bases [e.g.,f(x) = 9^x can be expressed as f(x) = 3^{2x}], and explain the connections between the equivalent forms in a variety of ways (e.g., comparing graphs; using transformations; using the exponent laws);

Solving Problems Involving Exponential Functions

- ☐ **EF3.01** **CR2006** – collect data that can be modelled as an exponential function, through investigation with and without technology, from primary sources, using a variety of tools (e.g., concrete materials such as number cubes, coins; measurement tools such as electronic probes), or from secondary sources (e.g., websites such as Statistics Canada, E-STAT), and graph the data (Sample problem: Collect data and graph the cooling curve representing the relationship between temperature and time for hot water cooling in a porcelain mug. Predict the shape of the cooling curve when hot water cools in an insulated mug. Test your prediction.);

Gr.11 Functions---Discrete Functions MCR 3U

Investigating Arithmetic and Geometric Sequences and Series

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **DF2.02** **CR2006** – determine the formula for the general term of an arithmetic sequence [i.e., $t_n = a + (n - 1)d$] or geometric sequence (i.e., $t_n = ar^{n-1}$), through investigation using a variety of tools (e.g., linking cubes, algebra tiles, diagrams, calculators) and strategies (e.g., patterning; connecting the steps in a numerical example to the steps in the algebraic development), and apply the formula to calculate any term in a sequence;
- ☐ **DF2.03** **CR2006** – determine the formula for the sum of an arithmetic or geometric series, through investigation using a variety of tools (e.g., linking cubes, algebra tiles, diagrams, calculators) and strategies (e.g., patterning; connecting the steps in a numerical example to the steps in the algebraic development), and apply the formula to calculate the sum of a given number of consecutive terms (Sample problem: Given the array built with grey and white connecting cubes, investigate how different ways of determining the total number of grey cubes can be used to evaluate the sum of the arithmetic series 1 + 2 + 3 + 4 + 5. Extend the series, use patterning to make generalizations for finding the sum, and test the generalizations for other arithmetic series.);(omitted graphic on page 38)

Solving Problems Involving Financial Applications

- ☐ **DF3.01** **CR2006** – make and describe connections between simple interest, arithmetic sequences, and linear growth, through investigation with technology (e.g., use a spreadsheet or graphing calculator to make simple interest calculations, determine first differences in the amounts over time, and graph amount versus time) [Sample problem: Describe an investment that could be represented by the function f (x) = 500(1.05x).];
- ☐ **DF3.02** **CR2006** – make and describe connections between compound interest, geometric sequences, and exponential growth, through investigation with technology (e.g., use a spreadsheet to make compound interest calculations, determine finite differences in the amounts over time, and graph amount versus time) [Sample problem: Describe an investment that could be represented by the function $f(x) = 500(1.05)^x$.];
- ☐ **DF3.03** **CR2006** – solve problems, using a scientific calculator, that involve the calculation of the amount, A (also referred to as future value, FV), the principal, P (also referred to as present value, PV), or the interest rate per compounding period, i, using the compound interest formula in the form $A = P(1 + i)^n$ [or $FV = PV(1 + i)^n$] (Sample problem: Two investments are available, one at 6% compounded annually and the other at 6% compounded monthly. Investigate graphically the growth of each investment, and determine the interest earned from depositing $1000 in each investment for 10 years.);
- ☐ **DF3.04** **CR2006** – determine, through investigation using technology (e.g., scientific calculator; the TVM solver in a graphing calculator; online tools), and describe strategies (e.g., guessing and checking; using the power of a power rule for exponents; using graphs) for calculating the number of compounding periods, n, using the compound interest formula in the form $A = P(1 + i)^n$ [or $FV = PV(1 + i)^n$], and solve related problems;
- ☐ **DF3.05** **CR2006** – explain the meaning of the term annuity, and determine the relationships between ordinary annuities, geometric series, and exponential growth, through investigation with technology in situations where the compounding period and the payment period are the same (e.g., use a spreadsheet to determine and graph the future value of an ordinary annuity for varying numbers of compounding periods; investigate how the contributions of each payment to the future value of an ordinary annuity are related to the terms of a geometric series);
- ☐ **DF3.06** **CR2006** – determine, through investigation using technology (e.g., the TVM Solver in a graphing calculator; online tools), the effects of changing the conditions (i.e., the payments, the frequency of the payments, the interest rate, the compounding period) of ordinary annuities in situations where the compounding period and the payment period are the same (e.g., long-term savings plans, loans) (Sample problem: Compare the amounts at age 65 that would result from making an annual deposit of $1000 starting at age 20, or from making an annual deposit of $3000 starting at age 50, to an RRSP that earns 6% interest per annum, compounded annually. What is the total of the deposits in each situation?);
- ☐ **DF3.07** **CR2006** – solve problems, using technology (e.g., scientific calculator, spreadsheet, graphing calculator), that involve the amount, the present value, and the regular payment of an ordinary annuity in situations where the compounding period and the payment period are the same (e.g., calculate the total interest paid over the life of a loan, using a spreadsheet, and compare the total interest with the original principal of the loan).

Gr.11 Functions---Trigonometric Functions MCR 3U

Determining and Applying Trigonometric Ratios

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **TF1.02** **CR2006** – determine the values of the sine, cosine, and tangent of angles from 0° to 360°, through investigation using a variety of tools (e.g., dynamic geometry software, graphing tools) and strategies (e.g., applying the unit circle; examining angles related to special angles);
- ☐ **TF1.06** **CR2006** – pose and solve problems involving right triangles and oblique triangles in two-dimensional settings, using the primary trigonometric ratios, the cosine law, and the sine law (including the ambiguous case);

Connecting Graphs and Equations of Sinusoidal Functions

- ☐ **TF2.03** **CR2006** – make connections between the sine ratio and the sine function and between the cosine ratio and the cosine function by graphing the relationship between angles from 0° to 360°and the corresponding sine ratios or cosine ratios, with or without technology (e.g., by generating a table of values using a calculator; by unwrapping the unit circle), defining this relationship as the function f(x) = sinx or f(x) = cosx, and explaining why the relationship is a function;
- ☐ **TF2.05** **CR2006** – determine, through investigation using technology, and describe the roles of the parameters a, k, d,and c in functions of the form y = af(k(x - d)) + c in terms of transformations on the graphs of f(x) = sinx and f(x) = cosx with angles expressed in degrees (i.e., translations; reflections in the axes; vertical and horizontal stretches and compressions) [Sample problem: Investigate the graph f(x) = 2sin(x -d) + 10 for various values of d, using technology, and describe the effects of changing d in terms of a transformation.];

Solving Problems Involving Sinusoidal Functions

- ☐ **TF3.01** **CR2006** – collect data that can be modelled as a sinusoidal function (e.g., voltage in an AC circuit, sound waves), through investigation with and without technology, from primary sources, using a variety of tools (e.g., concrete materials; measurement tools such as motion sensors), or from secondary sources (e.g., websites such as Statistics Canada, E-STAT), and graph the data (Sample problem: Measure and record distance-time data for a swinging pendulum, using a motion sensor or other measurement tools, and graph the data.);
- ☐ **TF3.03** **CR2006** – determine, through investigation, how sinusoidal functions can be used to model periodic phenomena that do not involve angles [Sample problem: Investigate,using graphing technology in degree mode, and explain how the function h(t) = 5sin(30(t + 3)) approximately models the relationship between the height and the time of day for a tide with an amplitude of 5 m, if high tide is at midnight.];
- ☐ **TF3.05** **CR2006** – pose and solve problems based on applications involving a sinusoidal function by using a given graph or a graph generated with technology from its equation [Sample problem: The height above the ground of a rider on a Ferris wheel can be modelled by the sine function h(t) = 25sin3(t - 30) + 27, where h(t) is the height, in metres, and t is the time, in seconds. Graph the function, using graphing technology in degree mode, and determine the maximum and minimum heights of the rider, the height after 30 s, and the time required to complete one revolution.].

Gr.12   Mathematics for College Technology---Mathematics Process Specific Expectations   MCT 4C

Representing

- ☐ **MPS.06** **CR2007** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.12   Mathematics for College Technology---A. EXPONENTIAL FUNCTIONS   MCT 4C

1. Solving Exponential Equations Graphically

- ☐ **EF1.01** **CR2007** 1.1 determine, through investigation with technology, and describe the impact of changing the base and changing the sign of the exponent on the graph of an exponential function
- ☐ **EF1.02** **CR2007** 1.2 solve simple exponential equations numerically and graphically, with technology (e.g., use systematic trial with a scientific calculator to determine the solution to the equation $1.05^x = 1{,}276$), and recognize that the solutions may not be exact Sample problem: Use the graph of $y = 3^x$ to solve the equation $3^x = 5$.

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

☐ **EF1.03 CR2007** 1.3 determine, through investigation using graphing technology, the point of intersection of the graphs of two exponential functions (e.g., $y = 4^{-x}$ and $y = 8^{x+3}$), recognize the x-coordinate of this point to be the solution to the corresponding exponential equation (e.g., $4^{-x} = 8^{x+3}$), and solve exponential equations graphically (e.g., solve $2^{x+2} = 2^x + 12$ by using the intersection of the graphs of $y = 2^{x+2}$ and $y = 2^x + 12$) Sample problem: Solve $0.5^x = 3^{x+3}$ graphically.

☐ **EF1.04 CR2007** 1.4 pose problems based on real-world applications (e.g., compound interest, population growth) that can be modelled with exponential equations, and solve these and other such problems by using a given graph or a graph generated with technology from a table of values or from its equation Sample problem: A tire with a slow puncture loses pressure at the rate of 4%/min. If the tire's pressure is 300 kPa to begin with, what is its pressure after 1 min? After 2 min? After 10 min? Use graphing technology to determine when the tire's pressure will be 200 kPa.

2. Solving Exponential Equations Algebraically

☐ **EF2.02 CR2007** 2.2 solve exponential equations in one variable by determining a common base (e.g., $2^x = 32$, $4^{5x-1} = 2^{2(x+11)}$, $3^{5x+8} = 27^x$) Sample problem: Solve $3^{5x+8} = 27^x$ by determining a common base, verify by substitution, and investigate connections to the intersection of $y = 3^{5x+8}$ and $y = 27^x$ using graphing technology.

☐ **EF2.04 CR2007** 2.4 determine, with technology, the approximate logarithm of a number to any base, including base 10 [e.g., by recognizing that $\log_{10}(0.372)$ can be determined using the LOG key on a calculator; by reasoning that $\log_3 29$ is between 3 and 4 and using systematic trial to determine that $\log_3 29$ is approximately 3.07]

Gr.12 Mathematics for College Technology---B. POLYNOMIAL FUNCTIONS MCT 4C

1. Investigating Graphs of Polynomial Functions

☐ **PF1.02 CR2007** 1.2 compare, through investigation using graphing technology, the graphical and algebraic representations of polynomial (i.e., linear, quadratic, cubic, quartic) functions (e.g., investigate the effect of the degree of a polynomial function on the shape of its graph and the maximum number of x-intercepts; investigate the effect of varying the sign of the leading coefficient on the end behaviour of the function for very large positive or negative x-values) Sample problem: Investigate the maximum number of x-intercepts for linear, quadratic, cubic, and quartic functions using graphing technology.

☐ **PF1.06 CR2007** 1.6 pose problems based on real-world applications that can be modelled with polynomial functions, and solve these and other such problems by using a given graph or a graph generated with technology from a table of values or from its equation

☐ **PF1.07 CR2007** 1.7 recognize, using graphs, the limitations of modelling a real-world relationship using a polynomial function, and identify and explain any restrictions on the domain and range (e.g., restrictions on the height and time for a polynomial function that models the relationship between height above the ground and time for a falling object) Sample problem: The forces acting on a horizontal support beam in a house cause it to sag by d centimetres, x metres from one end of the beam. The relationship between d and x can be represented by the polynomial function $d(x) = (1/1850)x(1000 – 20x^2 + x^3)$. Graph the function, using technology, and determine the domain over which the function models the relationship between d and x. Determine the length of the beam using the graph, and explain your reasoning.

2. Connecting Graphs and Equations of Polynomial Functions

☐ **PF2.02 CR2007** 2.2 make connections, through investigation using graphing technology (e.g., dynamic geometry software), between a polynomial function given in factored form [e.g., $f(x) = x(x – 1)(x + 1)$] and the x-intercepts of its graph, and sketch the graph of a polynomial function given in factored form using its key features (e.g., by determining intercepts and end behaviour; by locating positive and negative regions using test values between and on either side of the x-intercepts) Sample problem: Sketch the graphs of $f(x) = –(x – 1)(x + 2)(x – 4)$ and $g(x) = –(x – 1)(x + 2)(x + 2)$ and compare their shapes and the number of x-intercepts.

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **PF2.03** **CR2007** 2.3 determine, through investigation using technology (e.g., graphing calculator, computer algebra systems), and describe the connection between the real roots of a polynomial equation and the x-intercepts of the graph of the corresponding polynomial function [e.g., the real roots of the equation $x^4 – 13x^2 + 36 = 0$ are the x-intercepts of the graph of $f(x) = x^4 – 13x^2 + 36$] Sample problem: Describe the relationship between the x-intercepts of the graphs of linear and quadratic functions and the real roots of the corresponding equations. Investigate, using technology, whether this relationship exists for polynomial functions of higher degree.

3. Solving Problems Involving Polynomial Equations

- ☐ **PF3.01** **CR2007** 3.1 solve polynomial equations in one variable, of degree no higher than four (e.g., $x^2 – 4x = 0$, $x^4 – 16 = 0$, $3x^2 + 5x + 2 = 0$), by selecting and applying strategies (i.e., common factoring; difference of squares; trinomial factoring), and verify solutions using technology (e.g., using computer algebra systems to determine the roots of the equation; using graphing technology to determine the x-intercepts of the corresponding polynomial function) Sample problem: Solve $x^3 – 2x^2 – 8x = 0$.
- ☐ **PF3.07** **CR2007** 3.7 make connections between formulas and linear, quadratic, and exponential functions [e.g., recognize that the compound interest formula, $A = P(1 + i)^n$, is an example of an exponential function A(n) when P and i are constant, and of a linear function A(P) when i and n are constant], using a variety of tools and strategies (e.g., comparing the graphs generated with technology when different variables in a formula are set as constants) Sample problem: Which variable(s) in the formula $V = \pi r^2 h$ would you need to set as a constant to generate a linear equation? A quadratic equation?

Gr.12 Mathematics for College Technology---C. TRIGONOMETRIC FUNCTIONS MCT 4C

1. Applying Trigonometric Ratios

- ☐ **TF1.02** **CR2007** 1.2 determine the values of the sine, cosine, and tangent of angles from 0° to 360°, through investigation using a variety of tools (e.g., dynamic geometry software, graphing tools) and strategies (e.g., applying the unit circle; examining angles related to the special angles)
- ☐ **TF1.03** **CR2007** 1.3 determine the measures of two angles from 0° to 360° for which the value of a given trigonometric ratio is the same (e.g., determine one angle using a calculator and infer the other angle) Sample problem: Determine the approximate measures of the angles from 0° to 360° for which the sine is 0.3423.
- ☐ **TF1.05** **CR2007** 1.5 solve problems involving oblique triangles, including those that arise from real-world applications, using the sine law (including the ambiguous case) and the cosine law Sample problem: The following diagram represents a mechanism in which point B is fixed, point C is a pivot, and a slider A can move horizontally as angle B changes. The minimum value of angle B is 35°. How far is it from the extreme left position to the extreme right position of slider A? (omitted the graph on page 130)

2. Connecting Graphs and Equations of Sinusoidal Functions

- ☐ **TF2.01** **CR2007** 2.1 make connections between the sine ratio and the sine function and between the cosine ratio and the cosine function by graphing the relationship between angles from 0° to 360° and the corresponding sine ratios or cosine ratios, with or without technology (e.g., by generating a table of values using a calculator; by unwrapping the unit circle), defining this relationship as the function f(x) = sin x or f(x) = cos x, and explaining why the relationship is a function
- ☐ **TF2.03** **CR2007** 2.3 determine, through investigation using technology, the roles of the parameters d and c in functions of the form y = sin(x – d) + c and y = cos(x – d) + c, and describe these roles in terms of transformations on the graphs of f(x) = sin x and f(x) = cos x with angles expressed in degrees (i.e., vertical and horizontal translations) Sample problem: Investigate the graph f(x) = 2sin(x – d) + 10 for various values of d, using technology, and describe the effects of changing d in terms of a transformation.
- ☐ **TF2.04** **CR2007** 2.4 determine, through investigation using technology, the roles of the parameters a and k in functions of the form y = a sin kx and y = a cos kx, and describe these roles in terms of transformations on the graphs of f(x) = sin x and f(x) = cos x with angles expressed in degrees (i.e., reflections in the axes; vertical and horizontal stretches and compressions to and from the x- and y-axes) Sample problem: Investigate the graph f(x) = 2sin kx for various values of k, using technology, and describe the effects of changing k in terms of transformations.

3. Solving Problems Involving Sinusoidal Functions

☐ **TF3.01** **CR2007** 3.1 collect data that can be modelled as a sinusoidal function (e.g., voltage in an AC circuit, pressure in sound waves, the height of a tack on a bicycle wheel that is rotating at a fixed speed), through investigation with and without technology, from primary sources, using a variety of tools (e.g., concrete materials, measurement tools such as motion sensors), or from secondary sources (e.g., websites such as Statistics Canada, E-STAT), and graph the data Sample problem: Measure and record distance-time data for a swinging pendulum, using a motion sensor or other measurement tools, and graph the data. Describe how the graph would change if you moved the pendulum further away from the motion sensor. What would you do to generate a graph with a smaller amplitude?

☐ **TF3.03** **CR2007** 3.3 pose problems based on applications involving a sinusoidal function, and solve these and other such problems by using a given graph or a graph generated with technology, in degree mode, from a table of values or from its equation Sample problem: The height above the ground of a rider on a Ferris wheel can be modelled by the sinusoidal function $h(t) = 25\cos(3(t – 60)) + 27$, where $h(t)$ is the height in metres and t is the time in seconds. Graph the function, using graphing technology in degree mode, and determine the maximum and minimum heights of the rider, the height after 30 s, and the time required to complete one revolution.

Gr.12 Mathematics for College Technology---D. APPLICATIONS OF GEOMETRY MCT 4C

1. Modelling With Vectors

☐ **AG1.05** **CR2007** 1.5 determine, through investigation using a variety of tools (e.g., graph paper, technology) and strategies (i.e., head-to-tail method; parallelogram method; resolving vectors into their vertical and horizontal components), the sum (i.e., resultant) or difference of two vectors

2. Solving Problems Involving Geometry

☐ **AG2.01** **CR2007** 2.1 gather and interpret information about real-world applications of geometric shapes and figures in a variety of contexts in technology-related fields (e.g., product design, architecture), and explain these applications (e.g., one reason that sewer covers are round is to prevent them from falling into the sewer during removal and replacement) Sample problem: Explain why rectangular prisms are often used for packaging.

☐ **AG2.02** **CR2007** 2.2 perform required conversions between the imperial system and the metric system using a variety of tools (e.g., tables, calculators, online conversion tools), as necessary within applications

3. Solving Problems Involving Circle Properties

☐ **AG3.03** **CR2007** 3.3 determine, through investigation using a variety of tools (e.g., dynamic geometry software), properties of the circle associated with chords, central angles, inscribed angles, and tangents (e.g., equal chords or equal arcs subtend equal central angles and equal inscribed angles; a radius is perpendicular to a tangent at the point of tangency defined by the radius, and to a chord that the radius bisects) Sample problem: Investigate, using dynamic geometry software, the relationship between the lengths of two tangents drawn to a circle from a point outside the circle.

Gr.12 Calculus and Vectors---Mathematics Process Specific Expectations MCV 4U

Representing

☐ **MPS.06** **CR2007** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.12 Calculus and Vectors---A. RATE OF CHANGE MCV 4U

1. Investigating Instantaneous Rate of Change at a Point

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found

containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**

within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**

within: **Mathematics**

☐ **RC1.03 CR2007** 1.3 make connections, with or without graphing technology, between an approximate value of the instantaneous rate of change at a given point on the graph of a smooth function and average rates of change over intervals containing the point (i.e., by using secants through the given point on a smooth curve to approach the tangent at that point, and determining the slopes of the approaching secants to approximate the slope of the tangent)

☐ **RC1.04 CR2007** 1.4 recognize, through investigation with or without technology, graphical and numerical examples of limits, and explain the reasoning involved (e.g., the value of a function approaching an asymptote, the value of the ratio of successive terms in the Fibonacci sequence) Sample problem: Use appropriate technology to investigate the limiting value of the terms in the sequence $(1 + 1/1)^1$, $(1 + 1/2)^2$, $(1 + 1/3)^3$, $(1 + 1/4)^4$, ..., and the limiting value of the series 4 x 1 – 4 x 1/3 + 4 x 1/5 –4 x 1/7 + 4 x 1/9 – ....

2. Investigating the Concept of the Derivative Function

☐ **RC2.01 CR2007** 2.1 determine numerically and graphically the intervals over which the instantaneous rate of change is positive, negative, or zero for a function that is smooth over these intervals (e.g., by using graphing technology to examine the table of values and the slopes of tangents for a function whose equation is given; by examining a given graph), and describe the behaviour of the instantaneous rate of change at and between local maxima and minima Sample problem: Given a smooth function for which the slope of the tangent is always positive, explain how you know that the function is increasing. Give an example of such a function.

☐ **RC2.02 CR2007** 2.2 generate, through investigation using technology, a table of values showing the instantaneous rate of change of a polynomial function, f(x), for various values of x (e.g., construct a tangent to the function, measure its slope, and create a slider or animation to move the point of tangency), graph the ordered pairs, recognize that the graph represents a function called the derivative, f′(x) or dy/dx, and make connections between the graphs of f(x) and f′(x) or y and dy/dx [e.g., when f(x) is linear, f′(x) is constant; when f(x) is quadratic, f′(x) is linear; when f(x) is cubic, f′(x) is quadratic] Sample problem: Investigate, using patterning strategies and graphing technology, relationships between the equation of a polynomial function of degree no higher than 3 and the equation of its derivative.

☐ **RC2.04 CR2007** 2.4 determine, through investigation using technology, the graph of the derivative f′(x)or dy/dx of a given sinusoidal function [i.e., f(x) = sin x, f(x) = cos x] (e.g., by generating a table of values showing the instantaneous rate of change of the function for various values of x and graphing the ordered pairs; by using dynamic geometry software to verify graphically that when f(x) = sin x, f′(x) = cos x, and when f(x) = cos x, f′(x) =– sin x; by using a motion sensor to compare the displacement and velocity of a pendulum)

☐ **RC2.05 CR2007** 2.5 determine, through investigation using technology, the graph of the derivative f′(x)or dy/dx of a given exponential function [i.e., $f(x) = a^x$ $(a > 0, a \neq 1)$] [e.g., by generating a table of values showing the instantaneous rate of change of the function for various values of x and graphing the ordered pairs; by using dynamic geometry software to verify that when $f(x) = a^x$, f′(x) = kf(x)], and make connections between the graphs of f(x) and f′(x) or y and dy/dx [e.g., f(x) and f′(x) are both exponential; the ratio f′(x)/f(x) is constant, or f′(x) = kf(x); f′(x) is a vertical stretch from the x-axis of f(x)] Sample problem: Graph, with technology, $f(x) = a^x$ $(a > 0, a \neq 1)$ and f′(x) on the same set of axes for various values of a (e.g., 1.7, 2.0, 2.3, 3.0, 3.5). For each value of a, investigate the ratio f′(x)/f(x) for various values of x, and explain how you can use this ratio to determine the slopes of tangents to f(x).

☐ **RC2.06 CR2007** 2.6 determine, through investigation using technology, the exponential function $f(x) = a^x (a > 0, a \neq 1)$ for which f′(x) = f(x) (e.g., by using graphing technology to create a slider that varies the value of a in order to determine the exponential function whose graph is the same as the graph of its derivative), identify the number e to be the value of a for which f′(x) = f(x) [i.e., given $f(x) = e^x$, $f'(x) = e^x$], and recognize that for the exponential function $f(x) = e^x$ the slope of the tangent at any point on the function is equal to the value of the function at that point Sample problem: Use graphing technology to determine an approximate value of e by graphing $f(x) = a^x$ $(a > 0, a \neq 1)$ for various values of a, comparing the slope of the tangent at a point with the value of the function at that point, and identifying the value of a for which they are equal.

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

☐ **RC2.08 CR2007** 2.8 verify, using technology (e.g., calculator, graphing technology), that the derivative of the exponential function $f(x) = a^x$ is $f'(x) = a^x \ln a$ for various values of a [e.g., verifying numerically for $f(x) = 2^x$ that $f'(x) = 2^x \ln 2$ by using a calculator to show that $\lim_{h\to0} (2^h - 1)/h$ is ln 2 or by graphing $f(x) = 2^x$, determining the value of the slope and the value of the function for specific x-values, and comparing the ratio $f'(x)/f(x)$ with ln 2] Sample problem: Given $f(x) = e^x$, verify numerically with technology using $\lim_{h\to0} (e^{x+h} - e^x)/h$ that $f'(x) = f(x)\ln e$.

3. Investigating the Properties of Derivatives

☐ **RC3.02 CR2007** 3.2 verify the constant, constant multiple, sum, and difference rules graphically and numerically [e.g., by using the function $g(x) = kf(x)$ and comparing the graphs of $g'(x)$ and $kf'(x)$; by using a table of values to verify that $f'(x) + g'(x) = (f + g)'(x)$, given $f(x) = x$ and $g(x) = 3x$], and read and interpret proofs involving $\lim_{h\to0} [f(x + h) - f(x)]/h$ of the constant, constant multiple, sum, and difference rules (student reproduction of the development of the general case is not required)   Sample problem: The amounts of water flowing into two barrels are represented by the functions f(t) and g(t). Explain what f'(t), g'(t), f'(t) + g'(t), and (f + g)'(t) represent. Explain how you can use this context to verify the sum rule, f'(t) + g'(t) = (f + g)'(t).

Gr.12   Calculus and Vectors---B. DERIVATIVES AND THEIR APPLICATIONS   MCV 4U

1. Connecting Graphs and Equations of Functions and Their Derivatives

☐ **DA1.03 CR2007** 1.3 determine algebraically the equation of the second derivative f''(x) of a polynomial or simple rational function f(x), and make connections, through investigation using technology, between the key features of the graph of the function (e.g., increasing/decreasing intervals, local maxima and minima, points of inflection, intervals of concavity) and corresponding features of the graphs of its first and second derivatives (e.g., for an increasing interval of the function, the first derivative is positive; for a point of inflection of the function, the slopes of tangents change their behaviour from increasing to decreasing or from decreasing to increasing, the first derivative has a maximum or minimum, and the second derivative is zero)

Sample problem: Investigate, using graphing technology, connections between key properties, such as increasing/decreasing intervals, local maxima and minima, points of inflection, and intervals of concavity, of the functions $f(x) = 4x + 1$, $f(x) = x^2 + 3x - 10$, $f(x) = x^3 + 2x^2 - 3x$, and $f(x) = x^4 + 4x^3 - 3x^2 - 18x$ and the graphs of their first and second derivatives.

☐ **DA1.05 CR2007** 1.5 sketch the graph of a polynomial function, given its equation, by using a variety of strategies (e.g., using the sign of the first derivative; using the sign of the second derivative; identifying even or odd functions) to determine its key features (e.g., increasing/ decreasing intervals, intercepts, local maxima and minima, points of inflection, intervals of concavity), and verify using technology

2. Solving Problems Using Mathematical Models and Derivatives

☐ **DA2.01 CR2007** 2.1 make connections between the concept of motion (i.e., displacement, velocity, acceleration) and the concept of the derivative in a variety of ways (e.g., verbally, numerically, graphically, algebraically) Sample problem: Generate a displacement–time graph by walking in front of a motion sensor connected to a graphing calculator. Use your knowledge of derivatives to sketch the velocity–time and acceleration–time graphs. Verify the sketches by displaying the graphs on the graphing calculator.

☐ **DA2.03 CR2007** 2.3 solve problems, using the derivative, that involve instantaneous rates of change, including problems arising from real-world applications (e.g., population growth, radioactive decay, temperature changes, hours of day-light, heights of tides), given the equation of a function* Sample problem: The size of a population of butterflies is given by the function $P(t) = 6000/[1 + 49(0.6)^t]$ where t is the time in days. Determine the rate of growth in the population after 5 days using the derivative, and verify graphically using technology. *The emphasis of this expectation is on the application of the derivative rules and not on the simplification of resulting complex algebraic expressions.

Gr.12   Calculus and Vectors---C. GEOMETRY AND ALGEBRA OF VECTORS   MCV 4U

2. Operating With Vectors

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **GA2.02** **CR2007** 2.2 determine, through investigation with and without technology, some properties (e.g., commutative, associative, and distributive properties) of the operations of addition, subtraction, and scalar multiplication of vectors

3. Describing Lines and Planes Using Linear Equations

- ☐ **GA3.02** **CR2007** 3.2 determine, through investigation with technology (i.e., 3-D graphing software) and without technology, that the solution points (x, y, z) in three-space of a single linear equation in three variables form a plane and that the solution points (x, y, z) in three-space of a system of two linear equations in three variables form the line of intersection of two planes, if the planes are not coincident or parallel Sample problem: Use spatial reasoning to compare the shapes of the solutions in three-space with the shapes of the solutions in two-space for each of the linear equations x = 0, y = 0, and y = x. For each of the equations z = 5, y – z = 3, and x + z = 1, describe the shape of the solution points (x, y, z) in three-space. Verify the shapes of the solutions in three-space using technology.

Gr.12 Mathematics of Data Management---Mathematics Process Specific Expectations MDM 4U

Representing

- ☐ **MPS.06** **CR2007** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.12 Mathematics of Data Management---A. COUNTING AND PROBABILITY MDM 4U

1. Solving Probability Problems Involving Discrete Sample Spaces

- ☐ **CP1.04** **CR2007** 1.4 determine, through investigation using class-generated data and technology-based simulation models (e.g., using a random-number generator on a spreadsheet or on a graphing calculator; using dynamic statistical software to simulate repeated trials in an experiment), the tendency of experimental probability to approach theoretical probability as the number of trials in an experiment increases (e.g., "If I simulate tossing two coins 1000 times using technology, the experimental probability that I calculate for getting two tails on the two tosses is likely to be closer to the theoretical probability of 1/4 than if I simulate tossing the coins only 10 times")
  Sample problem: Calculate the theoretical probability of rolling a 2 on a single roll of a number cube. Simulate rolling a number cube, and use the simulation results to calculate the experimental probabilities of rolling a 2 over 10, 20, 30, ..., 200 trials. Graph the experimental probabilities versus the number of trials, and describe any trend.

Gr.12 Mathematics of Data Management---B. PROBABILITY DISTRIBUTIONS MDM 4U

1. Understanding Probability Distributions for Discrete Random Variables

- ☐ **PD1.01** **CR2007** 1.1 recognize and identify a discrete random variable X (i.e., a variable that assumes a unique value for each outcome of a discrete sample space, such as the value x for the outcome of getting x heads in 10 tosses of a coin), generate a probability distribution [i.e., a function that maps each value x of a random variable X to a corresponding probability, P(X = x)] by calculating the probabilities associated with all values of a random variable, with and without technology, and represent a probability distribution numerically using a table
- ☐ **PD1.02** **CR2007** 1.2 calculate the expected value for a given probability distribution [i.e., using $E(X) = \Sigma\, xP(X = x)$], interpret the expected value in applications, and make connections between the expected value and the weighted mean of the values of the discrete random variable Sample problem: Of six cases, three each hold $1, two each hold $1000, and one holds $100 000. Calculate the expected value and interpret its meaning. Make a conjecture about what happens to the expected value if you add $10 000 to each case or if you multiply the amount in each case by 10. Verify your conjectures.

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **PD1.06** **CR2007** 1.6 compare, with technology and using numeric and graphical representations, the probability distributions of discrete random variables (e.g., compare binomial distributions with the same probability of success for increasing numbers of trials; compare the shapes of a hypergeometric distribution and a binomial distribution) Sample problem: Compare the probability distributions associated with drawing 0, 1, 2, or 3 face cards when a card is drawn 3 times from a standard deck with replacement (i.e., the card is replaced after each draw) and without replacement (i.e., the card is not replaced after each draw).

2. Understanding Probability Distributions for Continuous Random Variables

- ☐ **PD2.02** **CR2007** 2.2 recognize standard deviation as a measure of the spread of a distribution, and determine, with and without technology, the mean and standard deviation of a sample of values of a continuous random variable
- ☐ **PD2.04** **CR2007** 2.4 represent, using intervals, a sample of values of a continuous random variable numerically using a frequency table and graphically using a frequency histogram and a frequency polygon, recognize that the frequency polygon approximates the frequency distribution, and determine, through investigation using technology (e.g., dynamic statistical software, graphing calculator), and compare the effectiveness of the frequency polygon as an approximation of the frequency distribution for different sizes of the intervals
- ☐ **PD2.07** **CR2007** 2.7 make connections, through investigation using dynamic statistical software, between the normal distribution and the binomial and hypergeometric distributions for increasing numbers of trials of the discrete distributions (e.g., recognizing that the shape of the hypergeometric distribution of the number of males on a 4-person committee selected from a group of people more closely resembles the shape of a normal distribution as the size of the group from which the committee was drawn increases) Sample problem: Explain how the total area of a probability histogram for a binomial distribution allows you to predict the area under a normal probability distribution curve.
- ☐ **PD2.08** **CR2007** 2.8 recognize a z-score as the positive or negative number of standard deviations from the mean to a value of the continuous random variable, and solve probability problems involving normal distributions using a variety of tools and strategies (e.g., calculating a z-score and reading a probability from a table; using technology to determine a probability), including problems arising from real-world applications Sample problem: The heights of 16-month-old maple seedlings are normally distributed with a mean of 32 cm and a standard deviation of 10.2 cm. What is the probability that the height of a randomly selected seedling will be between 24.0 cm and 38.0 cm?

Gr.12   Mathematics of Data Management---C. ORGANIZATION OF DATA FOR ANALYSIS   MDM 4U

2. Collecting and Organizing Data

- ☐ **OD2.05** **CR2007** 2.5 collect data from primary sources, through experimentation, or from secondary sources (e.g., by using the Internet to access reliable data from a well-organized database such as E-STAT; by using print sources such as newspapers and magazines), and organize data with one or more attributes (e.g., organize data about a music collection classified by artist, date of recording, and type of music using dynamic statistical software or a spreadsheet) to answer a question or solve a problem

Gr.12   Mathematics of Data Management---D. STATISTICAL ANALYSIS   MDM 4U

1. Analysing One-Variable Data

- ☐ **SA1.01** **CR2007** 1.1 recognize that the analysis of one-variable data involves the frequencies associated with one attribute, and determine, using technology, the relevant numerical summaries (i.e., mean, median, mode, range, interquartile range, variance, and standard deviation)
- ☐ **SA1.03** **CR2007** 1.3 generate, using technology, the relevant graphical summaries of one-variable data (e.g., circle graphs, bar graphs, histograms, stem-and-leaf plots, boxplots) based on the type of data provided (e.g., categorical, ordinal, quantitative)

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **SA1.04** **CR2007** — 1.4 interpret, for a normally distributed population, the meaning of a statistic qualified by a statement describing the margin of error and the confidence level (e.g., the meaning of a statistic that is accurate to within 3 percentage points, 19 times out of 20), and make connections, through investigation using technology (e.g., dynamic statistical software), between the sample size, the margin of error, and the confidence level (e.g., larger sample sizes create higher confidence levels for a given margin of error) Sample problem: Use census data from Statistics Canada to investigate, using dynamic statistical software, the minimum sample size such that the proportion of the sample opting for a particular consumer or voting choice is within 3 percentage points of the proportion of the population, 95% of the time (i.e., 19 times out of 20).

2. Analysing Two-Variable Data

- ☐ **SA2.01** **CR2007** — 2.1 recognize that the analysis of two-variable data involves the relationship between two attributes, recognize the correlation coefficient as a measure of the fit of the data to a linear model, and determine, using technology, the relevant numerical summaries (e.g., summary tables such as contingency tables; correlation coefficients) Sample problem: Organize data from Statistics Canada to analyse gender differences (e.g., using contingency tables; using correlation coefficients) related to a specific set of characteristics (e.g., average income, hours of unpaid housework).
- ☐ **SA2.03** **CR2007** — 2.3 generate, using technology, the relevant graphical summaries of two-variable data (e.g., scatter plots, side-by-side boxplots) based on the type of data provided (e.g., categorical, ordinal, quantitative)
- ☐ **SA2.04** **CR2007** — 2.4 determine, by performing a linear regression using technology, the equation of a line that models a suitable two-variable data set, determine the fit of an individual data point to the linear model (e.g., by using residuals to identify outliers), and recognize these processes as strategies for two-variable data analysis

Gr.12 Mathematics of Data Management---E. CULMINATING DATA MANAGEMENT INVESTIGATION MDM 4U

1. Designing and Carrying Out a Culminating Investigation

- ☐ **CD1.03** **CR2007** — 1.3 gather data related to the study of the problem (e.g., by using a survey; by using the Internet; by using a simulation) and organize the data (e.g., by setting up a database; by establishing intervals), with or without technology
- ☐ **CD1.04** **CR2007** — 1.4 interpret, analyse, and summarize data related to the study of the problem (e.g., generate and interpret numerical and graphical statistical summaries; recognize and apply a probability distribution model; calculate the expected value of a probability distribution), with or without technology

2. Presenting and Critiquing the Culminating Investigation

- ☐ **CD2.02** **CR2007** — 2.2 present a summary of the culminating investigation to an audience of their peers within a specified length of time, with technology (e.g. presentation software) or without technology

Gr.11 Mathematics for Work and Everyday Life---Mathematics Process Specific Expectations MEL 3E

Representing

- ☐ **MPS.06** **CR2006** — • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.11 Mathematics for Work and Everyday Life---Earning and Purchasing MEL 3E

Earning

- ☐ **EP1.04** **CR2006** — – solve problems, using technology (e.g., calculator, spreadsheet), and make decisions involving different remuneration methods and schedules (Sample problem: Two sales positions are available in sportswear stores. One pays an hourly rate of $11.25 for 40 h per week. The other pays a weekly salary of $375 for the same number of hours, plus a commission of 5% of sales. Under what conditions would each position be the better choice?).

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

Purchasing

- ☐ **EP3.04 CR2006** – calculate discounts, sale prices, and after-tax costs, using technology;
- ☐ **EP3.09 CR2006** – describe and compare, for different types of transactions, the extra costs that may be associated with making purchases (e.g., interest costs, exchange rates, shipping and handling costs, customs duty, insurance) (Sample problem: What are the various costs included in the final total for purchasing a digital audio player online from an American source? Using an online calculator, calculate the final cost, and describe how it compares with the cost of the purchase from a major retailer in Ontario.);

Gr.11 Mathematics for Work and Everyday Life---Saving, Investing, and Borrowing MEL 3E

Saving and Investing

- ☐ **SI2.01 CR2006** – determine, through investigation using technology (e.g., calculator, spreadsheet), the effect on simple interest of changes in the principal, interest rate, or time, and solve problems involving applications of simple interest;
- ☐ **SI2.02 CR2006** – determine, through investigation using technology, the compound interest for a given investment, using repeated calculations of simple interest for no more than 6 compounding periods (Sample problem: Someone deposits $5000 at 4% interest per annum, compounded semi-annually. How much interest accumulates in 3 years?);
- ☐ **SI2.04 CR2006** – determine, through investigation using technology (e.g., a TVM Solver in a graphing calculator or on a website), the effect on the future value of a compound interest investment of changing the total length of time, the interest rate, or the compounding period (Sample problem: Compare the results at age 40 of making a deposit of $1000 at age 20 or a deposit of $2000 at age 30, if both investments pay 6% interest per annum, compounded monthly.);
- ☐ **SI2.05 CR2006** – solve problems, using technology, that involve applications of compound interest to saving and investing.

Borrowing

- ☐ **SI3.03 CR2006** – calculate, using technology (e.g., calculator, spreadsheet), the total interest paid over the life of a personal loan, given the principal, the length of the loan, and the periodic payments, and use the calculations to justify the choice of a personal loan;
- ☐ **SI3.04 CR2006** – determine, using a variety of tools (e.g., spreadsheet template, online amortization tables), the effect of the length of time taken to repay a loan on the principal and interest components of a personal loan repayment;
- ☐ **SI3.05 CR2006** – compare, using a variety of tools (e.g., spreadsheet template, online amortization tables), the effects of various payment periods (e.g., monthly, biweekly) on the length of time taken to repay a loan and on the total interest paid;

Gr.11 Mathematics for Work and Everyday Life---Transportation and Travel MEL 3E

Owning and Operating a Vehicle

- ☐ **TT1.07 CR2006** – solve problems, using technology (e.g., calculator, spreadsheet), that involve the fixed costs (e.g., licence fee, insurance) and variable costs (e.g., maintenance, fuel) of owning and operating a vehicle (Sample problem: The rate at which a car consumes gasoline depends on the speed of the car. Use a given graph of gasoline consumption, in litres per 100 km, versus speed, in kilometres per hour, to determine how much gasoline is used to drive 500 km at speeds of 80 km/h, 100 km/h, and 120 km/h. Use the current price of gasoline to calculate the cost of driving 500 km at each of these speeds.).

Gr.12 Mathematics for Work and Everyday Life---Mathematics Process Specific Expectations MEL 4E

Representing

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **MPS.06** **CR2007** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.12 Mathematics for Work and Everyday Life---A. REASONING WITH DATA MEL 4E

1. Interpreting and Displaying Data

- ☐ **RD1.03** **CR2007** 1.3 collect categorical data from primary sources, through experimentation involving observation (e.g., by tracking food orders in restaurants offering healthy food options) or measurement, or from secondary sources (e.g., Internet databases, newspapers, magazines), and organize and store the data using a variety of tools (e.g., spreadsheets, dynamic statistical software) Sample problem: Observe cars that pass through a nearby intersection. Collect data on seatbelt usage or the number of passengers per car.
- ☐ **RD1.04** **CR2007** 1.4 represent categorical data by constructing graphs (e.g., bar graph, broken-line graph, circle graph) using a variety of tools (e.g., dynamic statistical software, graphing calculator, spreadsheet)
- ☐ **RD1.06** **CR2007** 1.6 make and justify conclusions about a topic of personal interest by collecting, organizing (e.g., using spreadsheets), representing (e.g., using graphs), and making inferences from categorical data from primary sources (i.e., collected through measurement or observation) or secondary sources (e.g., electronic data from databases such as E-STAT, data from newspapers or magazines)

2. Investigating Probability

- ☐ **RD2.05** **CR2007** 2.5 determine, through investigation using class-generated data and technology-based simulation models (e.g., using a random-number generator on a spreadsheet or on a graphing calculator), the tendency of experimental probability to approach theoretical probability as the number of trials in an experiment increases (e.g., "If I simulate tossing a coin 1000 times using technology, the experimental probability that I calculate for getting tails in any one toss is likely to be closer to the theoretical probability than if I simulate tossing the coin only 10 times")
  Sample problem: Calculate the theoretical probability of rolling a 2 on a number cube. Simulate rolling a number cube, and use the simulation to calculate the experimental probability of rolling a 2 after 10, 20, 30, ..., 200 trials. Graph the experimental probability versus the number of trials, and describe any trend.

Gr.12 Mathematics for Work and Everyday Life---B. PERSONAL FINANCE MEL 4E

Overall Expectations

- ☐ **PSV.02** **CR2007** 2. interpret, design, and adjust budgets for individuals and families described in case studies;

2. Designing Budgets

- ☐ **PS2.04** **CR2007** 2.4 design, with technology (e.g., using spreadsheet templates, budgeting software, online tools) and without technology (e.g., using budget templates), explain, and justify a monthly budget suitable for an individual or family described in a given case study that provides the specifics of the situation (e.g., income; personal responsibilities; expenses such as utilities, food, rent/mortgage, entertainment, transportation, charitable contributions; long-term savings goals)
- ☐ **PS2.06** **CR2007** 2.6 make adjustments to a budget to accommodate changes in circumstances (e.g., loss of hours at work, change of job, change in personal responsibilities, move to new accommodation, achievement of a long-term goal, major purchase), with technology (e.g., spreadsheet template, budgeting software)

Gr.12 Mathematics for Work and Everyday Life---C. APPLICATIONS OF MEASUREMENT MEL 4E

2. Applying Measurement and Design

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **AM2.08** **CR2007** 2.8 investigate, plan, design, and prepare a budget for a household improvement (e.g., landscaping a property; renovating a room), using appropriate technologies (e.g., design or decorating websites, design or drawing software, spreadsheet) Sample problem: Plan, design, and prepare a budget for the renovation of a 12-ft by 12-ft bedroom for under $2000. The renovations could include repainting the walls, replacing the carpet with hardwood flooring, and refurnishing the room.

3. Solving Measurement Problems Using Proportional Reasoning

- ☐ **AM3.01** **CR2007** 3.1 identify and describe applications of ratio and rate, and recognize and represent equivalent ratios (e.g., show that 4:6 represents the same ratio as 2:3 by showing that a ramp with a height of 4 m and a base of 6 m and a ramp with a height of 2 m and a base of 3 m are equally steep) and equivalent rates (e.g., recognize that paying $1.25 for 250 mL of tomato sauce is equivalent to paying $3.75 for 750 mL of the same sauce), using a variety of tools (e.g., concrete materials, diagrams, dynamic geometry software)

Gr.9 Foundations of Mathematics---Mathematical Process Specific Expectations MFM 1P

Representing

- ☐ **MPS.06** **SQC2005** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.9 Foundations of Mathematics---Number Sense and Algebra MFM 1P

Solving Problems Involving Proportional Reasoning

- ☐ **NA1.01** **SQC2005** – illustrate equivalent ratios, using a variety of tools (e.g., concrete materials, diagrams, dynamic geometry software) (e.g., show that 4:6 represents the same ratio as 2:3 by showing that a ramp with a height of 4 m and a base of 6 m and a ramp with a height of 2 m and a base of 3 m are equally steep);
- ☐ **NA1.03** **SQC2005** – solve for the unknown value in a proportion, using a variety of methods (e.g., concrete materials, algebraic reasoning, equivalent ratios, constant of proportionality) (Sample problem: Solve x/4 = 15/20.);
- ☐ **NA1.05** **SQC2005** – solve problems involving ratios, rates, and directly proportional relationships in various contexts (e.g., currency conversions, scale drawings, measurement), using a variety of methods (e.g., using algebraic reasoning, equivalent ratios, a constant of proportionality; using dynamic geometry software to construct and measure scale drawings) (Sample problem: Simple interest is directly proportional to the amount invested. If Luis invests $84 for one year and earns $1.26 in interest, how much would he earn in interest if he invested $235 for one year?);

Simplifying Expressions and Solving Equations

- ☐ **NA2.01** **SQC2005** – simplify numerical expressions involving integers and rational numbers, with and without the use of technology;* *The knowledge and skills described in this expectation are to be introduced as needed and applied and consolidated throughout the course.
- ☐ **NA2.04** **SQC2005** – substitute into and evaluate algebraic expressions involving exponents (i.e., evaluate expressions involving natural-number exponents with rational-number bases) [e.g., evaluate $(3/2)^3$ by hand and 9.83 by using a calculator]) (Sample problem: A movie theatre wants to compare the volumes of popcorn in two containers, a cube with edge length 8.1 cm and a cylinder with radius 4.5 cm and height 8.0 cm. Which container holds more popcorn?);* *The knowledge and skills described in this expectation are to be introduced as needed and applied and consolidated throughout the course.

Gr.9 Foundations of Mathematics---Linear Relations MFM 1P

Using Data Management to Investigate Relationships

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

☐ **LR1.03** **SQC2005** – carry out an investigation or experiment involving relationships between two variables, including the collection and organization of data, using appropriate methods, equipment, and/or technology (e.g., surveying; using measuring tools, scientific probes, the Internet) and techniques (e.g., making tables, drawing graphs) (Sample problem: Perform an experiment to measure and record the temperature of ice water in a plastic cup and ice water in a thermal mug over a 30 min period, for the purpose of comparison. What factors might affect the outcome of this experiment? How could you change the experiment to account for them?);

Determining Characteristics of Linear Relations

☐ **LR2.01** **SQC2005** – construct tables of values and graphs, using a variety of tools (e.g., graphing calculators, spreadsheets, graphing software, paper and pencil), to represent linear relations derived from descriptions of realistic situations (Sample problem: Construct a table of values and a graph to represent a monthly cellphone plan that costs $25, plus $0.10 per minute of airtime.);

☐ **LR2.02** **SQC2005** – construct tables of values, scatter plots, and lines or curves of best fit as appropriate, using a variety of tools (e.g., spreadsheets, graphing software, graphing calculators, paper and pencil), for linearly related and non-linearly related data collected from a variety of sources (e.g., experiments, electronic secondary sources, patterning with concrete materials) (Sample problem: Collect data, using concrete materials or dynamic geometry software, and construct a table of values, a scatter plot, and a line or curve of best fit to represent the following relationships: the volume and the height for a square-based prism with a fixed base; the volume and the side length of the base for a square-based prism with a fixed height.);

Connecting Various Representations of Linear Relations and Solving Problems Using the Representations

☐ **LR4.02** **SQC2005** – describe a situation that would explain the events illustrated by a given graph of a relationship between two variables (Sample problem: The walk of an individual is illustrated in the given graph, produced by a motion detector and a graphing calculator. Describe the walk [e.g., the initial distance from the motion detector, the rate of walk].);

Gr.9 Foundations of Mathematics---Measurement and Geometry MFM 1P

Overall Expectations

☐ **MGV.03** **SQC2005** • determine, through investigation facilitated by dynamic geometry software, geometric properties and relationships involving two-dimensional shapes, and apply the results to solving problems.

Investigating the Optimal Values of Measurements of Rectangles

☐ **MG1.01** **SQC2005** – determine the maximum area of a rectangle with a given perimeter by constructing a variety of rectangles, using a variety of tools (e.g., geoboards, graph paper, toothpicks, a pre-made dynamic geometry sketch), and by examining various values of the area as the side lengths change and the perimeter remains constant;

☐ **MG1.02** **SQC2005** – determine the minimum perimeter of a rectangle with a given area by constructing a variety of rectangles, using a variety of tools (e.g., geoboards, graph paper, a premade dynamic geometry sketch), and by examining various values of the side lengths and the perimeter as the area stays constant;

Solving Problems Involving Perimeter, Area, and Volume

☐ **MG2.04** **SQC2005** – develop, through investigation (e.g., using concrete materials), the formulas for the volume of a pyramid, a cone, and a sphere (e.g., use three-dimensional figures to show that the volume of a pyramid [or cone] is 1/3 the volume of a prism [or cylinder] with the same base and height, and therefore that Vpyramid = Vprism/3 or Vpyramid = ((area of base)(height))/3);

Investigating and Applying Geometric Relationships

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **MG3.01** **SQC2005** – determine, through investigation using a variety of tools (e.g., dynamic geometry software, concrete materials), and describe the properties and relationships of the interior and exterior angles of triangles, quadrilaterals, and other polygons, and apply the results to problems involving the angles of polygons (Sample problem:With the assistance of dynamic geometry software, determine the relationship between the sum of the interior angles of a polygon and the number of sides. Use your conclusion to determine the sum of the interior angles of a 20-sided polygon.);
- ☐ **MG3.02** **SQC2005** – determine, through investigation using a variety of tools (e.g., dynamic geometry software, concrete materials), and describe the properties and relationships of the angles formed by parallel lines cut by a transversal, and apply the results to problems involving parallel lines (e.g., given a diagram of a rectangular gate with a supporting diagonal beam, and given the measure of one angle in the diagram, use the angle properties of triangles and parallel lines to determine the measures of the other angles in the diagram);
- ☐ **MG3.03** **SQC2005** – create an original dynamic sketch, paperfolding design, or other illustration that incorporates some of the geometric properties from this section, or find and report on some real-life application(s) (e.g., in carpentry, sports, architecture) of the geometric properties.

Gr.10 Foundations of Mathematics---Mathematical Process Specific Expectations MFM 2P

Representing

- ☐ **MPS.06** **SQC2005** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.10 Foundations of Mathematics---Measurement and Trigonometry MFM 2P

Solving Problems Involving Similar Triangles

- ☐ **MT1.01** **SQC2005** – verify, through investigation (e.g., using dynamic geometry software, concrete materials), properties of similar triangles (e.g., given similar triangles, verify the equality of corresponding angles and the proportionality of corresponding sides);

Solving Problems Involving the Trigonometry of Right Triangles

- ☐ **MT2.01** **SQC2005** – determine, through investigation (e.g., using dynamic geometry software, concrete materials), the relationship between the ratio of two sides in a right triangle and the ratio of the two corresponding sides in a similar right triangle, and define the sine, cosine, and tangent ratios (e.g., sin A = opposite/hypotenuse);

Gr.10 Foundations of Mathematics---Modelling Linear Relations MFM 2P

Graphing and Writing Equations of Lines

- ☐ **ML2.02** **SQC2005** – identify, through investigation, $y = mx + b$ as a common form for the equation of a straight line, and identify the special cases $x = a$, $y = b$;
- ☐ **ML2.03** **SQC2005** – identify, through investigation with technology, the geometric significance of m and b in the equation $y = mx + b$;
- ☐ **ML2.04** **SQC2005** – identify, through investigation, properties of the slopes of lines and line segments (e.g., direction, positive or negative rate of change, steepness, parallelism), using graphing technology to facilitate investigations, where appropriate;

Solving and Interpreting Systems of Linear Equations

- ☐ **ML3.01** **SQC2005** – determine graphically the point of intersection of two linear relations (e.g., using graph paper, using technology) (Sample problem: Determine the point of intersection of $y + 2x = –5$ and $y = 2/3x + 3$, using an appropriate graphing technique, and verify.);

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

Gr.10 Foundations of Mathematics---Quadratic Relations of the Form y = ax2 + bx + c MFM 2P

Identifying Characteristics of Quadratic Relations

- ☐ **QR2.01 SQC2005** – collect data that can be represented as a quadratic relation, from experiments using appropriate equipment and technology (e.g., concrete materials, scientific probes, graphing calculators), or from secondary sources (e.g., the Internet, Statistics Canada); graph the data and draw a curve of best fit, if appropriate, with or without the use of technology (Sample problem: Make a 1 m ramp that makes a 15° angle with the floor. Place a can 30 cm up the ramp. Record the time it takes for the can to roll to the bottom. Repeat by placing the can 40 cm, 50 cm, and 60 cm up the ramp, and so on. Graph the data and draw the curve of best fit.);
- ☐ **QR2.02 SQC2005** – determine, through investigation using technology, that a quadratic relation of the form $y = ax^2 + bx + c$ (a not equal to 0) can be graphically represented as a parabola, and determine that the table of values yields a constant second difference (Sample problem: Graph the quadratic relation $y = x^2 – 4$, using technology. Observe the shape of the graph. Consider the corresponding table of values, and calculate the first and second differences. Repeat for a different quadratic relation. Describe your observations and make conclusions.);
- ☐ **QR2.03 SQC2005** – identify the key features of a graph of a parabola (i.e., the equation of the axis of symmetry, the coordinates of the vertex, the y-intercept, the zeros, and the maximum or minimum value), using a given graph or a graph generated with technology from its equation, and use the appropriate terminology to describe the features;
- ☐ **QR2.04 SQC2005** – compare, through investigation using technology, the graphical representations of a quadratic relation in the form $y = x^2 + bx + c$ and the same relation in the factored form $y = (x – r)(x – s)$ (i.e., the graphs are the same), and describe the connections between each algebraic representation and the graph [e.g., the y-intercept is c in the form $y = x^2 + bx + c$; the x-intercepts are r and s in the form $y = (x – r)(x – s)$] (Sample problem: Use a graphing calculator to compare the graphs of $y = x^2 + 2x – 8$ and $y = (x + 4)(x – 2)$. In what way(s) are the equations related? What information about the graph can you identify by looking at each equation? Make some conclusions from your observations, and check your conclusions with a different quadratic equation.).

Solving Problems by Interpreting Graphs of Quadratic Relations

- ☐ **QR3.01 SQC2005** – solve problems involving a quadratic relation by interpreting a given graph or a graph generated with technology from its equation (e.g., given an equation representing the height of a ball over elapsed time, use a graphing calculator or graphing software to graph the relation, and answer questions such as the following: What is the maximum height of the ball? After what length of time will the ball hit the ground? Over what time interval is the height of the ball greater than 3 m?);
- ☐ **QR3.02 SQC2005** – solve problems by interpreting the signifi- cance of the key features of graphs obtained by collecting experimental data involving quadratic relations (Sample problem: Roll a can up a ramp. Using a motion detector and a graphing calculator, record the motion of the can until it returns to its starting position, graph the distance from the starting position versus time, and draw the curve of best fit. Interpret the meanings of the vertex and the intercepts in terms of the experiment. Predict how the graph would change if you gave the can a harder push.Test your prediction.).

Gr.12 Advanced Functions---Mathematics Process Specific Expectations MHF 4U

Representing

- ☐ **MPS.06 CR2007** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.12 Advanced Functions---A. EXPONENTIAL AND LOGARITHMIC FUNCTIONS MHF 4U

1. Evaluating Logarithmic Expressions

- ☐ **EL1.02 CR2007** 1.2 determine, with technology, the approximate logarithm of a number to any base, including base 10 (e.g., by reasoning that $\log_3 29$ is between 3 and 4 and using systematic trial to determine that $\log_3 29$ is approximately 3.07)

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **EL1.04** **CR2007** 1.4 make connections between the laws of exponents and the laws of logarithms [e.g., use the statement $10^{a+b} = 10^a\ 10^b$ to deduce that $\log_{10} x + \log_{10} y = \log_{10}(xy)$], verify the laws of logarithms with or without technology (e.g., use patterning to verify the quotient law for logarithms by evaluating expressions such as $\log_{10}1000 – \log_{10}100$ and then rewriting the answer as a logarithmic term to the same base), and use the laws of logarithms to simplify and evaluate numerical expressions

2. Connecting Graphs and Equations of Logarithmic Functions

- ☐ **EL2.01** **CR2007** 2.1 determine, through investigation with technology (e.g., graphing calculator, spreadsheet) and without technology, key features (i.e., vertical and horizontal asymptotes, domain and range, intercepts, increasing/decreasing behaviour) of the graphs of logarithmic functions of the form $f(x) = \log_b x$, and make connections between the algebraic and graphical representations of these logarithmic functions Sample problem: Compare the key features of the graphs of $f(x) = \log_2 x$, $g(x) = \log_4 x$, and $h(x) = \log_8 x$ using graphing technology.
- ☐ **EL2.02** **CR2007** 2.2 recognize the relationship between an exponential function and the corresponding logarithmic function to be that of a function and its inverse, deduce that the graph of a logarithmic function is the reflection of the graph of the corresponding exponential function in the line y = x, and verify the deduction using technology Sample problem: Give examples to show that the inverse of a function is not necessarily a function. Use the key features of the graphs of logarithmic and exponential functions to give reasons why the inverse of an exponential function is a function.
- ☐ **EL2.03** **CR2007** 2.3 determine, through investigation using technology, the roles of the parameters d and c in functions of the form $y = \log_{10}(x – d) + c$ and the roles of the parameters a and k in functions of the form $y = a\log_{10}(kx)$, and describe these roles in terms of transformations on the graph of $f(x) = \log_{10}x$ (i.e., vertical and horizontal translations; reflections in the axes; vertical and horizontal stretches and compressions to and from the x-and y-axes) Sample problem: Investigate the graphs of $f(x) = \log_{10} (x) + c$, $f(x) = \log_{10}(x – d)$, $f(x) = a\log_{10} x$, and $f(x) = \log_{10}(kx)$ for various values of c, d, a, and k, using technology, describe the effects of changing these parameters in terms of transformations, and make connections to the transformations of other functions such as polynomial functions, exponential functions, and trigonometric functions.
- ☐ **EL2.04** **CR2007** 2.4 pose problems based on real-world applications of exponential and logarithmic functions (e.g., exponential growth and decay, the Richter scale, the pH scale, the decibel scale), and solve these and other such problems by using a given graph or a graph generated with technology from a table of values or from its equation Sample problem: The pH or acidity of a solution is given by the equation pH = –logC, where C is the concentration of $[H^+]$ ions in multiples of M = 1 mol/L. Use graphing software to graph this function. What is the change in pH if the solution is diluted from a concentration of 0.1M to a concentration of 0.01M? From 0.001M to 0.0001M? Describe the change in pH when the concentration of any acidic solution is reduced to 1/10 of its original concentration. Rearrange the given equation to determine concentration as a function of pH.

3. Solving Exponential and Logarithmic Equations

- ☐ **EL3.02** **CR2007** 3.2 solve exponential equations in one variable by determining a common base (e.g., solve $4^x = 8^{x+3}$ by expressing each side as a power of 2) and by using logarithms (e.g., solve $4^x = 8^{x+3}$ by taking the logarithm base 2 of both sides), recognizing that logarithms base 10 are commonly used (e.g., solving $3^x = 7$ by taking the logarithm base 10 of both sides) Sample problem: Solve $300(1.05)^n = 600$ and $2^{x+2} – 2^x = 12$ either by finding a common base or by taking logarithms, and explain your choice of method in each case.

Gr.12 Advanced Functions---B. TRIGONOMETRIC FUNCTIONS MHF 4U

1. Understanding and Applying Radian Measure

- ☐ **TF1.03** **CR2007** 1.3 determine, with technology, the primary trigonometric ratios (i.e., sine, cosine, tangent) and the reciprocal trigonometric ratios (i.e., cosecant, secant, cotangent) of angles expressed in radian measure
- ☐ **TF1.04** **CR2007** 1.4 determine, without technology, the exact values of the primary trigonometric ratios and the reciprocal trigonometric ratios for the special angles 0, $\pi/6$, $\pi/4$, $\pi/3$, $\pi/2$, and their multiples less than or equal to 2π

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

2. Connecting Graphs and Equations of Trigonometric Functions

- ☐ **TF2.02 CR2007** 2.2 make connections between the tangent ratio and the tangent function by using technology to graph the relationship between angles in radians and their tangent ratios and defining this relationship as the function f(x) = tan x, and describe key properties of the tangent function
- ☐ **TF2.03 CR2007** 2.3 graph, with technology and using the primary trigonometric functions, the reciprocal trigonometric functions (i.e., cosecant, secant, cotangent) for angle measures expressed in radians, determine and describe key properties of the reciprocal functions (e.g., state the domain, range, and period, and identify and explain the occurrence of asymptotes), and recognize notations used to represent the reciprocal functions [e.g., the reciprocal of f(x) = sinx can be represented using csc x, 1/f(x), or 1/sinx, but not using $f^{-1}(x)$ or $\sin^{-1}x$, which represent the inverse function]
- ☐ **TF2.07 CR2007** 2.7 pose problems based on applications involving a trigonometric function with domain expressed in radians (e.g., seasonal changes in temperature, heights of tides, hours of daylight, displacements for oscillating springs), and solve these and other such problems by using a given graph or a graph generated with or without technology from a table of values or from its equation Sample problem: The population size, P, of owls (predators) in a certain region can be modelled by the function P(t) = 1000 + 100 sin (πt/12), where t represents 12 the time in months. The population size, p, of mice (prey) in the same region is given by pt p(t) = 20 000 + 4000 cos (πt/12). Sketch the graphs of these functions, and pose and solve problems involving the relationships between the two populations over time.

3. Solving Trigonometric Equations

- ☐ **TF3.01 CR2007** 3.1 recognize equivalent trigonometric expressions [e.g., by using the angles in a right triangle to recognize that sin x and cos (π/2 – x) are equivalent; by using transformations to recognize that cos (x + π/2) and –sin x are equivalent], and verify equivalence using graphing technology
- ☐ **TF3.02 CR2007** 3.2 explore the algebraic development of the compound angle formulas (e.g., verify the formulas in numerical examples, using technology; follow a demonstration of the algebraic development [student reproduction of the development of the general case is not required]), and use the formulas to determine exact values of trigonometric ratios [e.g., determining the exact value of sin (π/12) by first rewriting it in terms of special angles as sin (π/4 – π/6)]
- ☐ **TF3.03 CR2007** 3.3 recognize that trigonometric identities are equations that are true for every value in the domain (i.e., a counter-example can be used to show that an equation is not an identity), prove trigonometric identities through the application of reasoning skills, using a variety of relationships (e.g., tan x = sin x/cos x; $\sin^2x + \cos^2x = 1$; the reciprocal identities; the compound angle formulas), and verify identities using technology Sample problem: Use the compound angle formulas to prove the double angle formulas.
- ☐ **TF3.04 CR2007** 3.4 solve linear and quadratic trigonometric equations, with and without graphing technology, for the domain of real values from 0 to 2π, and solve related problems Sample problem: Solve the following trigonometric equations for 0 ≤ x ≤ 2π, and verify by graphing with technology: 2sinx + 1 = 0; $2\sin^2x + \sin x - 1 = 0$; sin x = cos2x; cos2x = 1/2.

Gr.12 Advanced Functions---C. POLYNOMIAL AND RATIONAL FUNCTIONS MHF 4U

1. Connecting Graphs and Equations of Polynomial Functions

- ☐ **PO1.02 CR2007** 1.2 compare, through investigation using graphing technology, the numeric, graphical, and algebraic representations of polynomial (i.e., linear, quadratic, cubic, quartic) functions (e.g., compare finite differences in tables of values; investigate the effect of the degree of a polynomial function on the shape of its graph and the maximum number of x-intercepts; investigate the effect of varying the sign of the leading coefficient on the end behaviour of the function for very large positive or negative x-values) Sample problem: Investigate the maximum number of x-intercepts for linear, quadratic, cubic, and quartic functions using graphing technology.

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **PO1.05 CR2007** 1.5 make connections, through investigation using graphing technology (e.g., dynamic geometry software), between a polynomial function given in factored form [e.g., f(x) = 2(x – 3)(x + 2)(x – 1)] and the x-intercepts of its graph, and sketch the graph of a polynomial function given in factored form using its key features (e.g., by determining intercepts and end behaviour; by locating positive and negative regions using test values between and on either side of the x-intercepts) Sample problem: Investigate, using graphing technology, the x-intercepts and the shapes of the graphs of polynomial functions with one or more repeated factors, for example, f(x) = (x – 2)(x – 3), f(x) = (x – 2)(x – 2)(x – 3), f(x) = (x – 2)(x – 2)(x – 2)(x – 3), and f(x) = (x + 2)(x + 2)(x – 2)(x – 2)(x – 3), by considering whether the factor is repeated an even or an odd number of times. Use your conclusions to sketch f(x) = (x + 1)(x + 1)(x – 3)(x – 3), and verify using technology.
- ☐ **PO1.06 CR2007** 1.6 determine, through investigation using technology, the roles of the parameters a, k, d, and c in functions of the form y = af (k(x – d)) + c, and describe these roles in terms of transformations on the graphs of $f(x) = x^3$ and $f(x) = x^4$ (i.e., vertical and horizontal translations; reflections in the axes; vertical and horizontal stretches and compressions to and from the x-and y-axes) Sample problem: Investigate, using technology, the graph of $f(x) = 2(x – d)^3 + c$ for various values of d and c, and describe the effects of changing d and c in terms of transformations.
- ☐ **PO1.07 CR2007** 1.7 determine an equation of a polynomial function that satisfies a given set of conditions (e.g., degree of the polynomial, intercepts, points on the function), using methods appropriate to the situation (e.g., using the x-intercepts of the function; using a trial-and-error process with a graphing calculator or graphing software; using finite differences), and recognize that there may be more than one polynomial function that can satisfy a given set of conditions (e.g., an infinite number of polynomial functions satisfy the condition that they have three given x-intercepts) Sample problem: Determine an equation for a fifth-degree polynomial function that intersects the x-axis at only 5, 1, and –5, and sketch the graph of the function.
- ☐ **PO1.08 CR2007** 1.8 determine the equation of the family of polynomial functions with a given set of zeros and of the member of the family that passes through another given point [e.g., a family of polynomial functions of degree 3 with zeros 5, –3, and –2 is defined by the equation f(x) = k(x – 5)(x + 3)(x + 2), where k is a real number, $k \neq 0$; the member of the family that passes through (–1, 24) is f(x) =–2(x – 5)(x + 3)(x + 2)] Sample problem: Investigate, using graphing technology, and determine a polynomial function that can be used to model the function f(x) = sin x over the interval $0 \leq x \leq 2\pi$.
- ☐ **PO1.09 CR2007** 1.9 determine, through investigation, and compare the properties of even and odd polynomial functions [e.g., symmetry about the y-axis or the origin; the power of each term; the number of x-intercepts; f(x) = f(–x)or f(–x) = –f(x)], and determine whether a given polynomial function is even, odd, or neither Sample problem: Investigate numerically, graphically, and algebraically, with and without technology, the conditions under which an even function has an even number of x-intercepts.

2. Connecting Graphs and Equations of Rational Functions

- ☐ **PO2.01 CR2007** 2.1 determine, through investigation with and without technology, key features (i.e., vertical and horizontal asymptotes, domain and range, intercepts, positive/negative intervals, increasing/decreasing intervals) of the graphs of rational functions that are the reciprocals of linear and quadratic functions, and make connections between the algebraic and graphical representations of these rational functions [e.g., make connections between $f(x) = 1/[x^2 – 4]$ and its graph by using graphing technology and by reasoning that there are vertical asymptotes at x = 2 and x =–2 and a horizontal asymptote at y = 0 and that the function maintains the same sign as $f(x) = x^2 – 4]$ Sample problem: Investigate, with technology, the key features of the graphs of families of rational functions of the form f(x) = 1/(x + n), and $f(x) = 1/[x^2 + n]$ where n is an integer, and make connections between the equations and key features of the graphs.
- ☐ **PO2.02 CR2007** 2.2 determine, through investigation with and without technology, key features (i.e., vertical and horizontal asymptotes, domain and range, intercepts, positive/negative intervals, increasing/decreasing intervals) of the graphs of rational functions that have linear expressions in the numerator and denominator [e.g., f(x) = 2x/[x– 3], h(x) = x – 2/(3x + 4)], and make connections between the algebraic and graphical representations of these rational functions Sample problem: Investigate, using graphing technology, key features of the graphs of the family of rational functions of the form f(x) = 8x/(nx + 1) for n = 1, 2, 4, and 8, and make connections between the equations and the asymptotes.

3. Solving Polynomial and Rational Equations

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **PO3.01 CR2007** 3.1 make connections, through investigation using technology (e.g., computer algebra systems), between the polynomial function f(x), the divisor x – a, the remainder from the division f(x)/[x – a], and f(a) to verify the remainder theorem and the factor theorem Sample problem: Divide $f(x) = x^4 + 4x^3 – x^2 – 16x – 14$ by x – a for various integral values of a using a computer algebra system. Compare the remainder from each division with f(a).

- ☐ **PO3.03 CR2007** 3.3 determine, through investigation using technology (e.g., graphing calculator, computer algebra systems), the connection between the real roots of a polynomial equation and the x-intercepts of the graph of the corresponding polynomial function, and describe this connection [e.g., the real roots of the equation $x^4– 13x^2 + 36 = 0$ are the x-intercepts of the graph of $f(x) = x^4 – 13x^2 + 36$] Sample problem: Describe the relationship between the x-intercepts of the graphs of linear and quadratic functions and the real roots of the corresponding equations. Investigate, using technology, whether this relationship exists for polynomial functions of higher degree.

- ☐ **PO3.04 CR2007** 3.4 solve polynomial equations in one variable, of degree no higher than four (e.g., $2x^3– 3x^2 + 8x – 12 = 0$), by selecting and applying strategies (i.e., common factoring, difference of squares, trinomial factoring, factoring by grouping, remainder theorem, factor theorem), and verify solutions using technology (e.g., using computer algebra systems to determine the roots; using graphing technology to determine the x-intercepts of the graph of the corresponding polynomial function)

- ☐ **PO3.05 CR2007** 3.5 determine, through investigation using technology (e.g., graphing calculator, computer algebra systems), the connection between the real roots of a rational equation and the x-intercepts of the graph of the corresponding rational function, and describe this connection [e.g., the real root of the equation (x – 2)/(x – 3) = 0 is 2, which is the x-intercept of the function f(x) = (x – 2)/(x – 3); the equation 1/(x – 3) = 0 has no real roots, and the function f(x) = 1/(x – 3) does not intersect the x-axis]

- ☐ **PO3.06 CR2007** 3.6 solve simple rational equations in one variable algebraically, and verify solutions using technology (e.g., using computer algebra systems to determine the roots; using graphing technology to determine the x-intercepts of the graph of the corresponding rational function)

- ☐ **PO3.07 CR2007** 3.7 solve problems involving applications of polynomial and simple rational functions and equations [e.g., problems involving the factor theorem or remainder theorem, such as determining the values of k for which the function $f(x) = x^3 + 6x^2 + kx – 4$ gives the same remainder when divided by x – 1 and x + 2] Sample problem: Use long division to express the given function $f(x) = [x^2 + 3x – 5]/[x – 1]$ as the sum of a polynomial function and a rational function of the form A/(x – 1) (where A is a constant), make a conjecture about the relationship between the given function and the polynomial function for very large positive and negative x-values, and verify your conjecture using graphing technology.

4. Solving Inequalities Grade 12, University Preparation

- ☐ **PO4.02 CR2007** 4.2 determine solutions to polynomial inequalities in one variable [e.g., solve $f(x) \geq 0$, where $f(x) = x^3 – x^2 + 3x – 9$] and to simple rational inequalities in one variable by graphing the corresponding functions, using graphing technology, and identifying intervals for which x satisfies the inequalities

Gr.12 Advanced Functions---D. CHARACTERISTICS OF FUNCTIONS MHF 4U

1. Understanding Rates of Change

- ☐ **CF1.03 CR2007** 1.3 sketch a graph that represents a relationship involving rate of change, as described in words, and verify with technology (e.g., motion sensor) when possible Sample problem: John rides his bicycle at a constant cruising speed along a flat road. He then decelerates (i.e., decreases speed) as he climbs a hill. At the top, he accelerates (i.e., increases speed) on a flat road back to his constant cruising speed, and he then accelerates down a hill. Finally, he comes to another hill and glides to a stop as he starts to climb. Sketch a graph of John's speed versus time and a graph of his distance travelled versus time.

- ☐ **CF1.08 CR2007** 1.8 determine, through investigation using a variety of tools and strategies (e.g., using a table of values to calculate slopes of secants or graphing secants and measuring their slopes with technology), the approximate slope of the tangent to a given point on the graph of a function (e.g., quadratic, exponential, sinusoidal) by using the slopes of secants through the given point (e.g., investigating the slopes of secants that approach the tangent at that point more and more closely), and make connections to average and instantaneous rates of change

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

☐ **CF1.09 CR2007** 1.9 solve problems involving average and instantaneous rates of change, including problems arising from real-world applications, by using numerical and graphical methods (e.g., by using graphing technology to graph a tangent and measure its slope) Sample problem: The height, h metres, of a ball above the ground can be modelled by the function h(t) =– 5t^2 + 20t, where t is the time in seconds. Use average speeds to determine the approximate instantaneous speed at t = 3.

2. Combining Functions

☐ **CF2.01 CR2007** 2.1 determine, through investigation using graphing technology, key features (e.g., domain, range, maximum/minimum points, number of zeros) of the graphs of functions created by adding, subtracting, multiplying, or dividing functions [e.g., f(x) = 2^{-x} sin4x, g(x) = x^2 + 2^x, h(x) = sin x/cos x], and describe factors that affect these properties Sample problem: Investigate the effect of the behaviours of f(x) = sin x, f(x) = sin2x, and f(x) = sin4x on the shape of f(x) = sin x + sin2x + sin4x.

☐ **CF2.04 CR2007** 2.4 determine the composition of two functions [i.e., f(g(x))] numerically (i.e., by using a table of values) and graphically, with technology, for functions represented in a variety of ways (e.g., function machines, graphs, equations), and interpret the composition of two functions in real-world applications Sample problem: For a car travelling at a constant speed, the distance driven, d kilometres, is represented by d(t) = 80t, where t is the time in hours. The cost of gasoline, in dollars, for the drive is represented by C(d) = 0.09d. Determine numerically and interpret C(d(5)), and describe the relationship represented by C(d(t)).

☐ **CF2.05 CR2007** 2.5 determine algebraically the composition of two functions [i.e., f(g(x))], verify that f(g(x)) is not always equal to g(f(x)) [e.g., by determining f(g(x)) and g(f(x)), given f(x) = x + 1 and g(x) = 2x], and state the domain [i.e., by defining f(g(x)) for those x-values for which g(x) is defined and for which it is included in the domain of f(x)] and the range of the composition of two functions Sample problem: Determine f(g(x)) and g(f(x)) given f(x) = cos x and g(x) = 2x + 1, state the domain and range of f(g(x)) and g(f(x)), compare f(g(x)) with g(f(x)) algebraically, and verify numerically and graphically with technology.

☐ **CF2.06 CR2007** 2.6 solve problems involving the composition of two functions, including problems arising from real-world applications Sample problem: The speed of a car, v kilometres per hour, at a time of t hours is represented by v(t) = 40 + 3t + t^2. The rate of gasoline consumption of the car, c litres per kilometre, at a speed of v kilometres per hour is represented by c(v) = (v/500 – 0.1)^2 + 0.15. Determine algebraically c(v(t)), the rate of gasoline consumption as a function of time. Determine, using technology, the time when the car is running most economically during a four-hour trip.

☐ **CF2.08 CR2007** 2.8 make connections, through investigation using technology, between transformations (i.e., vertical and horizontal translations; reflections in the axes; vertical and horizontal stretches and compressions to and from the x-and y-axes) of simple functions f(x) [e.g., f(x) = x^3 + 20, f(x) = sin x, f(x) = log x] and the composition of these functions with a linear function of the form g(x) = A(x + B) Sample problem: Compare the graph of f(x) = x^2 with the graphs of f(g(x)) and g(f(x)), where g(x) = 2(x – d), for various values of d. Describe the effects of d in terms of transformations of f(x).

3. Using Function Models to Solve Problems

☐ **CF3.01 CR2007** 3.1 compare, through investigation using a variety of tools and strategies (e.g., graphing with technology; comparing algebraic representations; comparing finite differences in tables of values) the characteristics (e.g., key features of the graphs, forms of the equations) of various functions (i.e., polynomial, rational, trigonometric, exponential, logarithmic)

☐ **CF3.03 CR2007** 3.3 solve problems, using a variety of tools and strategies, including problems arising from real-world applications, by reasoning with functions and by applying concepts and procedures involving functions (e.g., by constructing a function model from data, using the model to determine mathematical results, and interpreting and communicating the results within the context of the problem) Sample problem: The pressure of a car tire with a slow leak is given in the following table of values: Time, t (min)*Pressure, P (kPa)*0*400*5*335*10*295*15*255*20*225*25*195*30*170 Use technology to investigate linear, quadratic, and exponential models for the relationship of the tire pressure and time, and describe how well each model fits the data. Use each model to predict the pressure after 60 min. Which model gives the most realistic answer?

Gr.9 Principles of Mathematics---Mathematical Process Specific Expectations MPM 1D

Representing

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **MPS.06 SQC2005** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.9 Principles of Mathematics---Number Sense and Algebra MPM 1D

Operating with Exponents

- ☐ **NA1.01 SQC2005** – substitute into and evaluate algebraic expressions involving exponents (i.e., evaluate expressions involving natural-number exponents with rational-number bases [e.g., evaluate $(3/2)^3$ by hand and 9.8^3 by using a calculator]) (Sample problem: A movie theatre wants to compare the volumes of popcorn in two containers, a cube with edge length 8.1 cm and a cylinder with radius 4.5 cm and height 8.0 cm. Which container holds more popcorn?);

Manipulating Expressions and Solving Equations

- ☐ **NA2.01 SQC2005** – simplify numerical expressions involving integers and rational numbers, with and without the use of technology;* *The knowledge and skills described in this expectation are to be introduced as needed and applied and consolidated throughout the course.

Gr.9 Principles of Mathematics---Linear Relationships MPM 1D

Using Data Management to Investigate

- ☐ **LR1.03 SQC2005** – design and carry out an investigation or experiment involving relationships between two variables, including the collection and organization of data, using appropriate methods, equipment, and/or technology (e.g., surveying; using measuring tools, scientific probes, the Internet) and techniques (e.g., making tables, drawing graphs) (Sample problem: Design and perform an experiment to measure and record the temperature of ice water in a plastic cup and ice water in a thermal mug over a 30 min period, for the purpose of comparison. What factors might affect the outcome of this experiment? How could you design the experiment to account for them?);

Understanding Characteristics of Linear Relations

- ☐ **LR2.01 SQC2005** – construct tables of values, graphs, and equations, using a variety of tools (e.g., graphing calculators, spreadsheets, graphing software, paper and pencil), to represent linear relations derived from descriptions of realistic situations (Sample problem: Construct a table of values, a graph, and an equation to represent a monthly cellphone plan that costs $25, plus $0.10 per minute of airtime.);
- ☐ **LR2.02 SQC2005** – construct tables of values, scatter plots, and lines or curves of best fit as appropriate, using a variety of tools (e.g., spreadsheets, graphing software, graphing calculators, paper and pencil), for linearly related and non-linearly related data collected from a variety of sources (e.g., experiments, electronic secondary sources, patterning with concrete materials) (Sample problem: Collect data, using concrete materials or dynamic geometry software, and construct a table of values, a scatter plot, and a line or curve of best fit to represent the following relationships: the volume and the height for a square-based prism with a fixed base; the volume and the side length of the base for a square-based prism with a fixed height.);
- ☐ **LR2.05 SQC2005** – determine the equation of a line of best fit for a scatter plot, using an informal process (e.g., using a movable line in dynamic statistical software; using a process of trial and error on a graphing calculator; determining the equation of the line joining two carefully chosen points on the scatter plot).

Connecting Various Representations of Linear Relations

- ☐ **LR3.02 SQC2005** – describe a situation that would explain the events illustrated by a given graph of a relationship between two variables (Sample problem: The walk of an individual is illustrated in the given graph, produced by a motion detector and a graphing calculator. Describe the walk [e.g., the initial distance from the motion detector, the rate of walk].);

Gr.9 Principles of Mathematics---Analytic Geometry MPM 1D

Investigating the Relationship Between the Equation of a Relation and the Shape of Its Graph

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **AG1.01** **SQC2005** – determine, through investigation, the characteristics that distinguish the equation of a straight line from the equations of nonlinear relations (e.g., use a graphing calculator or graphing software to graph a variety of linear and non-linear relations from their equations; classify the relations according to the shapes of their graphs; connect an equation of degree one to a linear relation);

Investigating the Properties of Slope

- ☐ **AG2.02** **SQC2005** – identify, through investigation with technology, the geometric significance of m and b in the equation y = mx + b;
- ☐ **AG2.04** **SQC2005** – identify, through investigation, properties of the slopes of lines and line segments (e.g., direction, positive or negative rate of change, steepness, parallelism, perpendicularity), using graphing technology to facilitate investigations, where appropriate.

Using the Properties of Linear Relations to Solve Problems

- ☐ **AG3.02** **SQC2005** – determine the equation of a line from information about the line (e.g., the slope and y-intercept; the slope and a point; two points) (Sample problem: Compare the equations of the lines parallel to and perpendicular to y = 2x – 4, and with the same x-intercept as 3x – 4y = 12.Verify using dynamic geometry software.);

Gr.9 Principles of Mathematics---Measurement and Geometry MPM 1D

Overall Expectations

- ☐ **MGV.03** **SQC2005** • verify, through investigation facilitated by dynamic geometry software, geometric properties and relationships involving two-dimensional shapes, and apply the results to solving problems.

Investigating the Optimal Value of Measurements

- ☐ **MG1.01** **SQC2005** – determine the maximum area of a rectangle with a given perimeter by constructing a variety of rectangles, using a variety of tools (e.g., geoboards, graph paper, toothpicks, a pre-made dynamic geometry sketch), and by examining various values of the area as the side lengths change and the perimeter remains constant;
- ☐ **MG1.02** **SQC2005** – determine the minimum perimeter of a rectangle with a given area by constructing a variety of rectangles, using a variety of tools (e.g., geoboards, graph paper, a premade dynamic geometry sketch), and by examining various values of the side lengths and the perimeter as the area stays constant;
- ☐ **MG1.03** **SQC2005** – identify, through investigation with a variety of tools (e.g. concrete materials, computer software), the effect of varying the dimensions on the surface area [or volume] of square-based prisms and cylinders, given a fixed volume [or surface area];

Solving Problems Involving Perimeter, Area, Surface Area and Volume

- ☐ **MG2.04** **SQC2005** – develop, through investigation (e.g., using concrete materials), the formulas for the volume of a pyramid, a cone, and a sphere (e.g., use three-dimensional figures to show that the volume of a pyramid [or cone] is 1/3 the volume of a prism [or cylinder] with the same base and height, and therefore that Vpyramid = Vprism/3 or Vpyramid = ((area of base)(height))/3);

Investigating and Applying Geometric Relationships

- ☐ **MG3.01** **SQC2005** – determine, through investigation using a variety of tools (e.g., dynamic geometry software, concrete materials), and describe the properties and relationships of the interior and exterior angles of triangles, quadrilaterals, and other polygons, and apply the results to problems involving the angles of polygons (Sample problem:With the assistance of dynamic geometry software, determine the relationship between the sum of the interior angles of a polygon and the number of sides. Use your conclusion to determine the sum of the interior angles of a 20-sided polygon.);

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **MG3.02** **SQC2005** – determine, through investigation using a variety of tools (e.g., dynamic geometry software, paper folding), and describe some properties of polygons (e.g., the figure that results from joining the midpoints of the sides of a quadrilateral is a parallelogram; the diagonals of a rectangle bisect each other; the line segment joining the midpoints of two sides of a triangle is half the length of the third side), and apply the results in problem solving (e.g., given the width of the base of an A-frame tree house, determine the length of a horizontal support beam that is attached half way up the sloping sides);
- ☐ **MG3.03** **SQC2005** – pose questions about geometric relationships, investigate them, and present their findings, using a variety of mathematical forms (e.g., written explanations, diagrams, dynamic sketches, formulas, tables) (Sample problem: How many diagonals can be drawn from one vertex of a 20-sided polygon? How can I find out without counting them?);
- ☐ **MG3.04** **SQC2005** – illustrate a statement about a geometric property by demonstrating the statement with multiple examples, or deny the statement on the basis of a counter-example, with or without the use of dynamic geometry software (Sample problem: Confirm or deny the following statement: If a quadrilateral has perpendicular diagonals, then it is a square.).

Gr.9 Mathematics Transfer---Mathematics Process Specific Expectations MPM 1H

Representing

- ☐ **MPS.06** **CR2006** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.9 Mathematics Transfer---Analytic Geometry MPM 1H

Understanding Characteristics of Linear Relations

- ☐ **AG1.01** **CR2006** – design and carry out an investigation or experiment involving relationships between two variables, including the collection and organization of data, using appropriate methods, equipment, and/or technology (e.g., surveying; using measuring tools, scientific probes, the Internet) and techniques (e.g.,making tables, drawing graphs) (Sample problem: Design and perform an experiment to measure and record the temperature of ice water in a plastic cup and ice water in a thermal mug over a 30 min period, for the purpose of comparison. What factors might affect the outcome of this experiment? How could you design the experiment to account for them?);
- ☐ **AG1.02** **CR2006** – construct equations to represent linear relations derived from descriptions of realistic situations, and connect the equations to tables of values and graphs, using a variety of tools (e.g., graphing calculators, spreadsheets, graphing software, paper and pencil) (Sample problem: Construct a table of values, a graph, and an equation to represent a monthly cellphone plan that costs $25, plus $0.10 per minute of airtime.);
- ☐ **AG1.03** **CR2006** – determine the equation of a line of best fit for a scatter plot, using an informal process (e.g., using a movable line in dynamic statistical software; using a process of trial and error on a graphing calculator; determining the equation of the line joining two carefully chosen points on the scatter plot).

Investigating the Relationship Between the Equation of a Relation and the Shape of Its Graph

- ☐ **AG2.01** **CR2006** – determine, through investigation, the characteristics that distinguish the equation of a straight line from the equations of non-linear relations (e.g., use a graphing calculator or graphing software to graph a variety of linear and non-linear relations from their equations; classify the relations according to the shapes of their graphs; connect an equation of degree one to a linear relation);

Investigating the Properties of Slope

- ☐ **AG3.02** **CR2006** – identify, through investigation with technology, the geometric significance of m and b in the equation y = mx + b;
- ☐ **AG3.04** **CR2006** – identify, through investigation, properties of the slopes of lines and line segments (e.g., direction, positive or negative rate of change, steepness, parallelism, perpendicularity), using graphing technology to facilitate investigations, where appropriate.

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

Using the Properties of Linear Relations to Solve Problems

- ☐ **AG4.02** **CR2006** – determine the equation of a line from information about the line (e.g., the slope and y-intercept; the slope and a point; two points) (Sample problem: Compare the equations of the lines parallel to and perpendicular to y = 2x – 4, and with the same x-intercept as 3x – 4y = 12.Verify using dynamic geometry software.);

Gr.9 Mathematics Transfer---Measurement and Geometry MPM 1H

Overall Expectations

- ☐ **MGV.02** **CR2006** • verify, through investigation facilitated by dynamic geometry software, geometric properties and relationships involving two-dimensional shapes, and apply the results to solving problems.

Solving Problems Involving Surface Area and Volume

- ☐ **MG1.04** **CR2006** – identify, through investigation with a variety of tools (e.g. concrete materials, computer software), the effect of varying the dimensions on the surface area [or volume] of square-based prisms and cylinders, given a fixed volume [or surface area];

Investigating and Applying Geometric Relationships

- ☐ **MG2.01** **CR2006** – determine, through investigation using a variety of tools (e.g., dynamic geometry software, paper folding), and describe some properties of polygons (e.g., the figure that results from joining the midpoints of the sides of a quadrilateral is a parallelogram; the diagonals of a rectangle bisect each other; the line segment joining the midpoints of two sides of a triangle is half the length of the third side), and apply the results in problem solving (e.g., given the width of the base of an A-frame tree house, determine the length of a horizontal support beam that is attached half way up the sloping sides);
- ☐ **MG2.02** **CR2006** – pose questions about geometric relationships, investigate them, and present their findings, using a variety of mathematical forms (e.g., written explanations, diagrams, dynamic sketches, formulas, tables) (Sample problem: How many diagonals can be drawn from one vertex of a 20- sided polygon? How can I find out without counting them?);
- ☐ **MG2.03** **CR2006** – illustrate a statement about a geometric property by demonstrating the statement with multiple examples, or deny the statement on the basis of a counter-example, with or without the use of dynamic geometry software (Sample problem: Confirm or deny the following statement: If a quadrilateral has perpendicular diagonals, then it is a square.).

Gr.10 Principles of Mathematics---Mathematical Process Specific Expectations MPM 2D

Representing

- ☐ **MPS.06** **SQC2005** • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Gr.10 Principles of Mathematics---Quadratic Relations of the Form y = ax2 + bx + c MPM 2D

Investigating the Basic Properties of Quadratic Relations

- ☐ **QR1.01** **SQC2005** – collect data that can be represented as a quadratic relation, from experiments using appropriate equipment and technology (e.g., concrete materials, scientific probes, graphing calculators), or from secondary sources (e.g., the Internet, Statistics Canada); graph the data and draw a curve of best fit, if appropriate, with or without the use of technology (Sample problem: Make a 1 m ramp that makes a 15° angle with the floor. Place a can 30 cm up the ramp. Record the time it takes for the can to roll to the bottom. Repeat by placing the can 40 cm, 50 cm, and 60 cm up the ramp, and so on. Graph the data and draw the curve of best fit.);

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **QR1.02 SQC2005** – determine, through investigation with and without the use of technology, that a quadratic relation of the form $y = ax^2 + bx + c$ (a not equal to 0) can be graphically represented as a parabola, and that the table of values yields a constant second difference (Sample problem: Graph the relation $y = x^2 – 4x$ by developing a table of values and plotting points. Observe the shape of the graph. Calculate first and second differences. Repeat for different quadratic relations. Describe your observations and make conclusions, using the appropriate terminology.);
- ☐ **QR1.04 SQC2005** – compare, through investigation using technology, the features of the graph of $y = x^2$ and the graph of $y = 2^x$, and determine the meaning of a negative exponent and of zero as an exponent (e.g., by examining patterns in a table of values for $y = 2^x$; by applying the exponent rules for multiplication and division).

Relating the Graph of $y = x^2$ and Its Transformations

- ☐ **QR2.01 SQC2005** – identify, through investigation using technology, the effect on the graph of $y = x^2$ of transformations (i.e., translations, reflections in the x-axis, vertical stretches or compressions) by considering separately each parameter a, h, and k [i.e., investigate the effect on the graph of $y = x^2$ of a, h, and k in $y = x^2 + k$, $y = (x – h)^2$, and $y = ax^2$];
- ☐ **QR2.03 SQC2005** – sketch, by hand, the graph of $y = a(x – h)^2 + k$ by applying transformations to the graph of $y = x^2$ [Sample problem: Sketch the graph of $y = –1/2 (x – 3)^2 + 4$, and verify using technology.];

Solving Quadratic Equations

- ☐ **QR3.02 SQC2005** – factor polynomial expressions involving common factors, trinomials, and differences of squares [e.g., $2x^2 + 4x$, $2x – 2y + ax – ay$, $x^2 – x – 6$, $2a^2 + 11a + 5$, $4x^2 – 25$], using a variety of tools (e.g., concrete materials, computer algebra systems, paper and pencil) and strategies (e.g., patterning);
- ☐ **QR3.04 SQC2005** – interpret real and non-real roots of quadratic equations, through investigation using graphing technology, and relate the roots to the x-intercepts of the corresponding relations;
- ☐ **QR3.05 SQC2005** – express $y = ax^2 + bx + c$ in the form $y = a(x – h)^2 + k$ by completing the square in situations involving no fractions, using a variety of tools (e.g. concrete materials, diagrams, paper and pencil);
- ☐ **QR3.06 SQC2005** – sketch or graph a quadratic relation whose equation is given in the form $y = ax^2 + bx + c$, using a variety of methods (e.g., sketching $y = x^2 – 2x – 8$ using intercepts and symmetry; sketching $y = 3x^2 – 12x + 1$ by completing the square and applying transformations; graphing $h = –4.9t^2 + 50t + 1.5$ using technology);
- ☐ **QR3.07 SQC2005** – explore the algebraic development of the quadratic formula (e.g., given the algebraic development, connect the steps to a numerical example; follow a demonstration of the algebraic development [student reproduction of the development of the general case is not required]);
- ☐ **QR3.08 SQC2005** – solve quadratic equations that have real roots, using a variety of methods (i.e., factoring, using the quadratic formula, graphing) (Sample problem: Solve $x^2 + 10x + 16 = 0$ by factoring, and verify algebraically. Solve $x^2 + x – 4 = 0$ using the quadratic formula, and verify graphically using technology. Solve $–4.9t^2 + 50t + 1.5 = 0$ by graphing $h = –4.9t^2 + 50t + 1.5$ using technology.).

Solving Problems Involving Quadratic Relations

- ☐ **QR4.01 SQC2005** – determine the zeros and the maximum or minimum value of a quadratic relation from its graph (i.e., using graphing calculators or graphing software) or from its defining equation (i.e., by applying algebraic techniques);
- ☐ **QR4.02 SQC2005** – solve problems arising from a realistic situation represented by a graph or an equation of a quadratic relation, with and without the use of technology (e.g., given the graph or the equation of a quadratic relation representing the height of a ball over elapsed time, answer questions such as the following: What is the maximum height of the ball? After what length of time will the ball hit the ground? Over what time interval is the height of the ball greater than 3 m?).

Gr.10 Principles of Mathematics---Analytic Geometry MPM 2D

Solving Problems Involving the Properties of Line Segments

Printed for none: Friday, June 13, 2008 11:01 PM

FIND RESULTS: 361 expectations were found
containing the term(s): **"dynamic" OR "concrete material" OR "technology" OR "spreadsheet" OR "CAS" OR "calculator"**
within: **Gr.7, Gr.8, Gr.9, Gr.10, Gr.11, Gr.12**
within: **Mathematics**

- ☐ **AG2.01** **SQC2005** – develop the formula for the midpoint of a line segment, and use this formula to solve problems (e.g., determine the coordinates of the midpoints of the sides of a triangle, given the coordinates of the vertices, and verify concretely or by using dynamic geometry software);
- ☐ **AG2.02** **SQC2005** – develop the formula for the length of a line segment, and use this formula to solve problems (e.g., determine the lengths of the line segments joining the midpoints of the sides of a triangle, given the coordinates of the vertices of the triangle, and verify using dynamic geometry software);
- ☐ **AG2.05** **SQC2005** – solve problems involving the slope, length, and midpoint of a line segment (e.g., determine the equation of the right bisector of a line segment, given the coordinates of the endpoints; determine the distance from a given point to a line whose equation is given, and verify using dynamic geometry software).

Using Analytic Geometry to Verify Geometric Properties

- ☐ **AG3.01** **SQC2005** – determine, through investigation (e.g., using dynamic geometry software, by paper folding), some characteristics and properties of geometric figures (e.g., medians in a triangle, similar figures constructed on the sides of a right triangle);
- ☐ **AG3.03** **SQC2005** – plan and implement a multi-step strategy that uses analytic geometry and algebraic techniques to verify a geometric property (e.g., given the coordinates of the vertices of a triangle, verify that the line segment joining the midpoints of two sides of the triangle is parallel to the third side and half its length, and check using dynamic geometry software; given the coordinates of the vertices of a rectangle, verify that the diagonals of the rectangle bisect each other).

Gr.10 Principles of Mathematics---Trigonometry MPM 2D

Investigating Similarity and Solving Problems Involving Similar Triangles

- ☐ **TR1.01** **SQC2005** – verify, through investigation (e.g., using dynamic geometry software, concrete materials), the properties of similar triangles (e.g., given similar triangles, verify the equality of corresponding angles and the proportionality of corresponding sides);

Solving Problems Involving the Trigonometry of Right Triangles

- ☐ **TR2.01** **SQC2005** – determine, through investigation (e.g., using dynamic geometry software, concrete materials), the relationship between the ratio of two sides in a right triangle and the ratio of the two corresponding sides in a similar right triangle, and define the sine, cosine, and tangent ratios (e.g., sin A = opposite/hypotenuse);

Solving Problems Involving the Trigonometry of Acute Triangles

- ☐ **TR3.01** **SQC2005** – explore the development of the sine law within acute triangles (e.g., use dynamic geometry software to determine that the ratio of the side lengths equals the ratio of the sines of the opposite angles; follow the algebraic development of the sine law and identify the application of solving systems of equations [student reproduction of the development of the formula is not required]);
- ☐ **TR3.02** **SQC2005** – explore the development of the cosine law within acute triangles (e.g., use dynamic geometry software to verify the cosine law; follow the algebraic development of the cosine law and identify its relationship to the Pythagorean theorem and the cosine ratio [student reproduction of the development of the formula is not required]);
- ☐ **TR3.03** **SQC2005** – determine the measures of sides and angles in acute triangles, using the sine law and the cosine law (Sample problem: In triangle ABC, LA = 35°, LB = 65°, and AC = 18 cm. Determine BC. Check your result using dynamic geometry software.);